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ABSTRACT

Activities which stress ecological concepts make up the major portion of this curriculum guide. Designed as a 12 week mini-course for students in grades eight and nine, the guide first presents the course schedule, including time requirements, lists the ecological concepts to be studied, and correlates the concepts with the activities. Following an Orientation unit, the major topics or units of study include: Introduction to Interrelationships, Nature's Law of Supply and Demand, To Each His Own, "The Only Thing Constant is Change," and Adversity and Diversity. Each unit is composed of a series of pre, major, and post-activities beginning with a general overview indicating the title of the unit, time allotments, purpose or objective, and abstract of the content. Individual activities enumerate, where appropriate, specific goals, background information, major points to emphasize, teaching procedures, materials required, and supplemental activities or information. A variety of media and processes is suggested to allow for flexibility and use of the material at any grade level. This work was prepared under a contract for an ESEA Title III project, "Environmental Science Study Curriculum." (BL)

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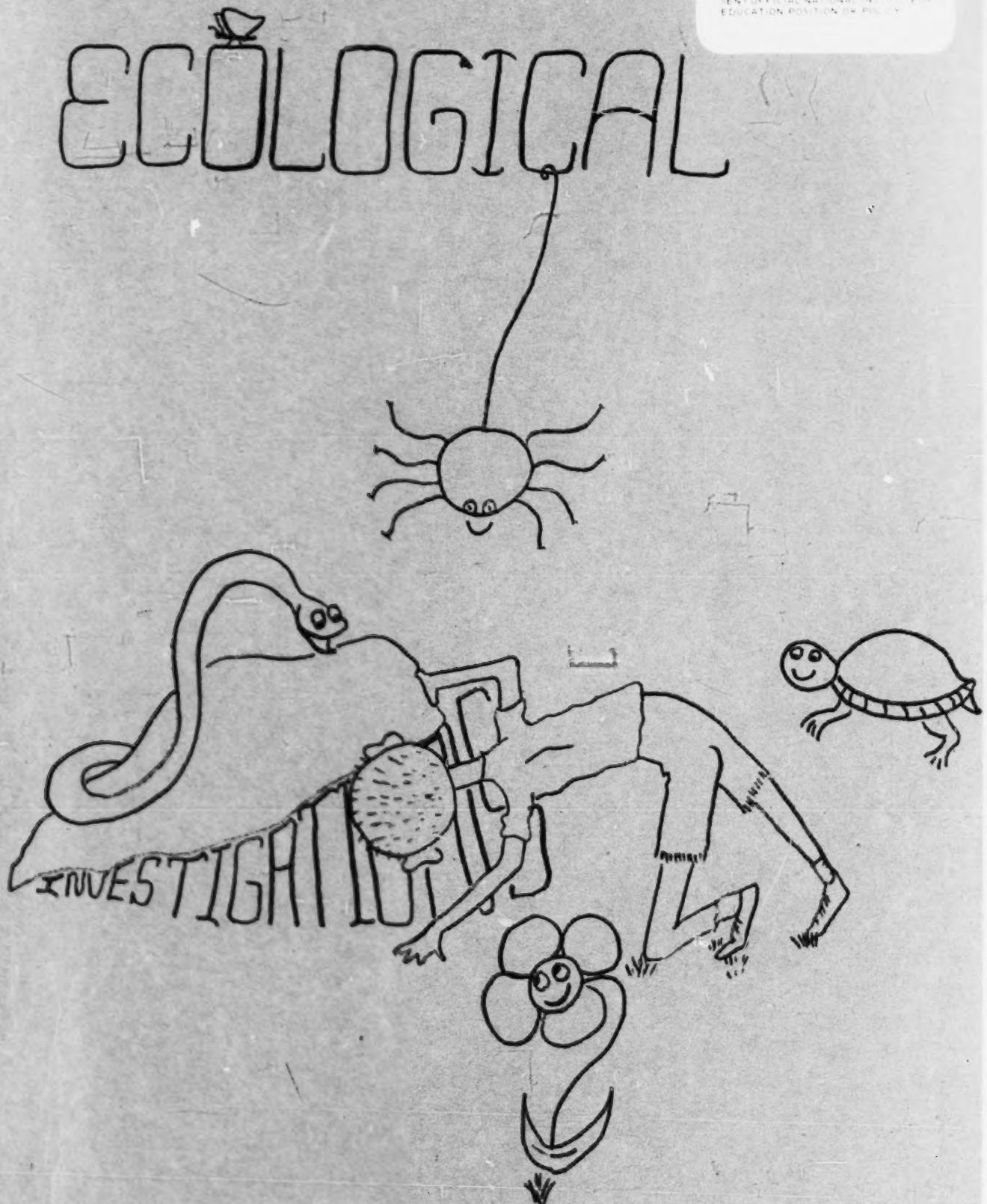
ECOLOGICAL



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PUBLISHER'S NOTE

Environmental Science Study Curriculum, (ESSC) is an ESEA Title III project funded through the State of North Carolina. One purpose of project ESSC is to develop a curriculum in environmental education at the eighth and ninth grade levels. The structure of the curriculum is based on the mini-course design. Currently, there are six twelve-week mini-courses, "Ecological Investigations" being one such course. Although the materials contained herein are designed for the specified grade levels, they could be utilized over a wider span of grades with relatively little revision.

Another purpose of the project is to review as much of the available and existing materials as possible and to utilize them wherever possible. Therefore, not all of the materials and ideas contained herein are the original work of project ESSC, rather some of this material is the result of using, evaluating, reworking, combining, synthesizing and re-evaluating existing materials from many varied sources. It is for this reason, however, that we are unable to credit all the original sources on those materials that are not original ideas of Project ESSC.

It is the hope of Project ESSC that this material and these unit plans are presented in such a manner that they will be readily usable. This entire course or any part thereof may be reproduced without any further permission from Project ESSC. However, we do ask that credit be given if the total course is reproduced.

The illustrations, as well as the sample test answers in Unit III, were done by an eighth grade student, Judy Meier.

ECOLOGICAL INVESTIGATIONS

A Curriculum Guide

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INTRODUCTION

Ecological Investigations has been designed for maximum flexibility: variations can readily be made in unit arrangement, level of sophistication, and time allotment.

The entire course may be taught in twelve to fourteen weeks. The course, however, is divided into discreet units which may be taught in any sequence. Units can be added or deleted without disrupting the effectiveness of the other units and conceptual scheme. The major ecological concepts stressed in each unit vary (Supplement # 1); yet each unit can be readily altered (e.g. using appropriate discussions and reference material) to intensify the learning of a concept or even to introduce additional concepts. At least two separate activities are included within each unit for reinforcement of major concepts. Each activity within a unit, however, may be used as a separate entity. The basic structure of the course, including topics studied and activities undertaken, can be simplified or advanced to suit nearly any grade level and degree of student ability. In any one class, with all the students working on the same activity, each student can achieve success and learn according to his own ability. The most advanced student can be challenged by the same activity that stimulates and intrigues the slowest learner. The teacher can facilitate this adaptability by continuously posing questions to and encouraging inquiry by each individual student commensurate with his ability. The supplements consist of quizzes, study sheets, inquiry-oriented questions, and lab material that have been successfully used by eighth and ninth grade students. They can be modified or replaced (or omitted) as necessary. Likewise, specific teaching methods are offered as suggestions only. As teachers and students vary, so must teaching technique.

No attempt has been made to extensively investigate every ecological concept and principle. The goal, instead, has been to provide students with a basic understanding of ecology through maximum student involvement and enjoyment.

Ecology is not sealed within the pages of a book. . . nor is it best revealed in a forest: it is in the school yard, behind the students' homes, within the cracks in the sidewalk, and in the vacant lot across the street. The outdoor activities included, therefore, can be used near any school building and probably within walking distance.

Likewise, costs are minimal. Biology texts include an adequate section on ecology. A bibliography is included, however, for each unit. Most equipment can be made by the students or teacher. An equipment list is also included with each unit. Films are suggested, but are not essential.

Enthusiasm and total involvement are infectious. A teacher with mud on his knees and enthusiasm on his face, supported by an activity-oriented and student-centered curriculum, is guaranteed success!

COURSE SCHEDULE

*UNIT	ACTIVITY	**PERIODS
I. Orientation	Is Ecology Square?	2
	A Sense Situation	1
II. Introduction to Interrelationships	Pictoral Dictionary of Ecology Terms	2
	An Ecosystem In One Square Foot	2
	Genesis: The Building of an Ecosystem	
	Part I - Indoors	5
	Part II - Outdoors	indefinite
III. Nature's Law of Supply and Demand	The Food Web Entanglement	4
	A Towering Puzzle	4
IV. To Each His Own	The Adaptation Angle	3
	A Transect Study - The Ecologists' "Thing"	10
	An Adaptable Treasure Hunt	2
V. "The Only Thing Constant is Change"	A Progressive Field Trip	4
	***Change in the Unseen World	4
VI. Adversity and Diversity	Simulating Survival Under Stress	4
	Can You Predict Peril?	1

*See Supplement # 1 and 2 for list of concepts stressed in each unit and activity.

**Time for quizzes has not been included. Each period is 55 minutes in length.

***This is a microscopic study of succession as it occurs in hay infusion. The teacher must begin preparing the hay infusion four to six weeks before the students study it. Supplement # 36 contains details.

SUPPLEMENT # 1

Ecological Concepts (Key to Supplement # 2)

I. All organisms are interdependent and dependent upon their physical environment.

   A. Populations are limited by biological and physical factors, thus maintaining a balance in nature.

   B. Organisms compete with each other for food, shelter, and space.

   C. Symbiosis (mutualism, commensalism, parasitism) and territoriality are means to lessening competition.

II. Man is an integral part of an ecosystem and capable of vastly affecting it.

III. Environments are constantly changing due to both physical and biological influences (stress).

   A. Organisms continuously alter their own environment, making it less inhabitable for themselves, but perhaps more inhabitable for other species.

   B. Each species has structural and physiological characteristics enabling it to function successfully in its habitat and niche.

   C. Organisms that cannot adapt to change die.

   D. The successful organism is one that survives and reproduces.

   E. Change, as the result of environmental stress, may not be immediately evident, sometimes requiring months or years to be effected.

IV. The more diversity there is (pertaining to an individual, a species, a community, or an ecosystem), the more stability there is. Man is a simplifier of ecosystems.

V. The earth can be compared to a giant spaceship. We have now on earth all the matter we ever will have. This matter must be (and is) reused (recycled).

VI. All life on earth depends upon solar energy.

   A. Energy does not cycle. Solar energy must be continually introduced in an ecosystem since most useful energy is lost (mainly as heat) as it passes through food chains.

Supplement # 1 (Cont.)

B. Food chains require a broad base. That is, because of the inefficiency of energy transfer, a food chain must be supported by huge amounts of producer organisms.

SUPPLEMENT # 2

Major Concepts Stressed

UNIT	*MAIN CONCEPTS	ACTIVITIES	*MAIN/COROLLARY CONCEPTS
I. Orientation	(none)		
II. Introduction to Interrelationships	I	Pictorial Dictionary of Ecological Terms	I
		An Ecosystem in One Square Foot	I, III B, V, VI
		Genesis: The Building of an Ecosystem	I, II, III, IV, V, VI
III. Nature's Law of Supply and Demand	V, VI	The Food Web Entanglement	I, II, III, IV, V, VI
		A Towering Puzzle	I, II, III, V, VI
IV. To Each His Own	I, III B, C	The Adaptation Angle	I B, III B
		A Transect Study-The Ecologists' Thing	I A; III A, B, C, E; IV; V; VI
		An Adaptable Treasure Hunt	III B
V. "The Only Thing Constant is Change"	III	A Progressive Field Trip	I, II, III, IV
		Change in the Unseen World	I, III
VI. Adversity and Diversity	IV	Simulating Survival Under Stress	I, II, III, IV
		Can You Predict Peril?	I, II, III, IV

*See Supplement # 1 for key

Films for Ecological Investigations

Purchase or Rental:

Nature's Half Acre (color, 33 minutes). Walt Disney Education Material Company, 1700 Gately Drive, Richmond, Virginia 23233.
Depicts the continuity of life among birds, plants, and insects. Stresses interdependency.

Microscopic Life: The World Of The Invisible (B/W, 11 minutes). Rental $8.00 Encyclopedia Britannica Educational Corp. 425 N. Michigan Avenue, Chicago, Illinois 60611.
Aids in the identification of microscopic organisms typically found in ponds or hay infusions.

The Single-Celled Animals - Protozoa (color, 17 minutes). Rental $8.00 Encyclopedia Britannica Educational Corp. 425 N. Michigan Avenue, Chicago, Illinois 60611.
Aids in the identification of protozoa.

Succession From Sand Dune To Forest (color, 20 minutes). Rental $8.00 Encyclopedia Britannica Educational Corp. 425 N. Michigan Avenue, Chicago, Illinois 60611.
Excellent presentation of succession. Stresses interdependency.

Animal Adaptations In A Northern Environment (color, 11 minutes). Rental $8.00. BFA Educational Media. 2211 Michigan Avenue, Santa Monica, California 90404.
Describes how various animals adapt to the arctic tundra.

Adaptation To Ocean Environments (color, 11 minutes). Rental $8.00. BFA Educational Media, 2211 Michigan Avenue, Santa Monica, California 90404.
Discusses the relationship between animal structures and the physical environmental factors that must be faced.

Life In The Sea. (B/W, 11 minutes). Rental $2.00. University of North Carolina. Bureau of Audiovisual Education. 111 Abernathy Hall, Chapel Hill, North Carolina
Describes life forms in the sea and interdependencies. Discusses food chains.

Seashore Life. (color, 10 minutes). Rental $4.00. University of North Carolina. Bureau of Audiovisual Education. 111 Abernathy Hall, Chapel Hill, North Carolina
Portrays life on three kinds of seashore and adaptations of animals to their special environment.

Loan (Free):

Wildlife Babies. (color, 25 minutes). Division of Education. Wildlife Resources Commission. P. O. Box 2919, Raleigh, North Carolina 27602.
Depicts the young of a number of wildlife species in their natural habitat. Beautiful photography.

A Way Of Life. (color, 27 minutes). Division of Education. Wildlife Resources Commission. P. O. Box 2919, Raleigh, North Carolina 27602.
Explains the important role predators play in maintaining the balance of nature.

Conservation And Balance In Nature. (color, 18 minutes). Division of Education. Wildlife Resources Commission. P. O. Box 2919. Raleigh, North Carolina 27602.
A simple review of ecological principles.

UNIT I PLAN

UNIT I TITLE: ORIENTATION

TIME: 3 periods

PURPOSE OR OBJECTIVE:

Sometimes it is advantageous to allow a couple of days for both student and teacher to get to know each other. In addition, a short activity or two at the beginning of a course can provide the student with an encouraging hint of good things to come and pique curiosity and enthusiasm.

ABSTRACT:

The first activity, "Is Ecology Square?", involves the students in a group effort at constructing a three-dimensional collage that portrays the groups' concept of what the term ecology means to them. The second activity, "A Sense Situation", is a walking and sitting field study that requires the students to record every sensual impression they receive.

UNIT I SCHEDULE

Is Ecology Square?	Activity	1 period
	Post-Activity	1 period
A Sense Situation	Activity	$\frac{1}{2}$ period
	Post-Activity	$\frac{1}{2}$ period

UNIT I: ORIENTATION

INTRODUCTION TO ACTIVITY

Is Ecology Square?

TIME: 2 periods

GOAL:

To superficially evaluate the student's level of understanding of ecology and his expectations concerning course content.

To provide an atmosphere conducive to getting acquainted and becoming accustomed to working together and sharing ideas.

INTRODUCTION:

Students will not be certain they know exactly what ecology is, but they will have an impression or opinion based upon past experiences. This activity is designed so they can get to know each other better, express and share their definitions of ecology, and stimulate their imagination. They can be told that at the end of the course each will be asked to evaluate his collage: Does it display a complete definition of ecology? What concept or idea has been overlooked? What is incorrect?

MATERIALS

PER GROUP OF 4

1 small cardboard box (or squares of cardboard that can be used to make a mobile)

old magazines, preferably wildlife oriented

string to attach to box so it may be suspended from the ceiling (or to construct a mobile)

*scissors

*marking pens or crayons

scotch tape, paste, or masking tape

*optional

ACTIVITY PLANS

Is Ecology Square?

UNIT I: ORIENTATION

TIME: 1 period

TO THE TEACHER:

Explain to the students that they are each to work in a group (of 3-5 students) to construct a 3-dimensional collage (by pasting pictures on all sides of the box) that displays the group's collective idea of what ecology is. Each group will select a speaker to explain its collage to the class.

SUGGESTIONS:

1. Establish group membership by numbering the students from 1 to 4 and designating that all students with the same number form a group. (Hopefully, this will be somewhat random.)

2. Assist the students in obtaining materials and encourage the expression of their ideas, but do not <u>give</u> them ideas or suggestions.

3. Ask the students to write their names inside the box and attach a length of string to the box so the collage can be hung from the ceiling the next day.

POST-ACTIVITY PLANS

Is Ecology Square?

UNIT I: ORIENTATION

TIME: 1 period

EITHER -

Each group explains the relevance of its pictures to ecology. Students from other groups are encouraged to delve deeper, asking questions that may clarify or extend the meaning implied by the collage.

OR -

The students exchange collages and try to explain what they think <u>each others'</u> definition of ecology is, based upon the pictures that were selected. The 'creators' of the collage may then want to verify the explanation or defend the pictures that had been misinterpreted.

NOTE: Even a 'slow' group can do the latter successfully. The latter suggestion has the dual advantages of (1) relaxing the atmosphere among the students who may be timid about justifying their <u>own</u> work and (2) stimulating the students' imagination while challenging their ability to reason. The alternative procedures can be offered as choices.

UNIT I: ORIENTATION

INTRODUCTION TO ACTIVITY

A Sense Situation

TIME: 1 period

GOAL:

To get the students outdoors, where their objects of study are physically located!

To provide students with an opportunity to evaluate the keenness of their own senses.

To stimulate within each student a more sensual, physical awareness of his external environment.

INTRODUCTION:

Students should be notified in advance that they will need to wear old clothing and perhaps bring something on which to sit if the ground is wet. They wouldn't necessarily have to be told any more than that. The teacher should attempt to find an area within walking distance of the school. The area may be an empty lot, a wooded area, or even the school campus or front lawns of nearby homes (with permission).

MATERIALS:

PER STUDENT	TEACHER
2 sheets of paper	whistle
pencil	
hard surface on which to write	

ACTIVITY PLANS

A Sense Situation

UNIT I: ORIENTATION

TIME: ½ period

TO THE TEACHER:

At the beginning of class, tell students to assemble their paper and pencil and follow you to the designated study area. Instruct the students to walk away by themselves and either continue to walk slowly or, preferably, sit still without speaking for 10-15 minutes until they hear the whistle which is the signal to reassemble. While they are alone they must record everything they sense (smell, touch, hear, see).

When all have reassembled, ask the students to study their lists carefully (some may want to read their lists to the others) and determine which sense(s) they have utilized the least. Instruct them to once again walk away for 10 minutes, this time concentrating on the sense(s) they neglected the first time. They may be asked to pay particular attention to those stimuli immediately surrounding them (e.g. smell a leaf, feel the soil).

SUGGESTIONS:

1. Time for recording will vary depending upon the time necessary to walk to the study site and the length of the class period. These factors need to be considered in advance.

2. After the first recording it is advisable to allow perhaps two students (who have good lists) to read their lists to the others as a good example for others to emulate (i.e. stimulating others to perhaps be more sensitive to their environment).

POST-ACTIVITY PLANS

A Sense Situation

UNIT I: ORIENTATION

TIME: ½ period

TO THE TEACHER:

When the second 10-minute recording has elapsed, students should regroup. You may then ask them to evaluate and compare their lists. Did they sense more the second time? Do they think they have been using all their senses as much as they could. . . or should? What do they feel they have gained by this activity?

SUGGESTIONS:

1. You may want to read each student's observations and indicate whether or not that student is using all his senses as much as he could.
2. A justification of this activity is that an ecologist must be extremely sensitive to his environment. The students may be asked to explain why this statement is true.

UNIT II PLAN

UNIT II TITLE: INTRODUCTION TO INTERRELATIONSHIPS

TIME: at least 10 periods

PURPOSE OR OBJECTIVE:

The primary purpose of this unit is to provide experiences for the student that help to build the concept of interrelationships that take place among all living things and their environment--both biological and physical. Students also discover why organisms are interdependent. Additionally, the activities help develop such generalized skills as learning to plan ahead, how to use reference materials, cooperating with a team, and teach responsibility not only to other people but to other species as well.

ABSTRACT:

The students become familiar with fundamental ecological terms by preparing a pictorial dictionary of teacher-selected vocabulary words. The unit also contains a trip to an old field ("An Ecosystem In One Square Foot"), where the students study one square foot of earth, record everything on and under this area, and analyze the interrelationships therein. Extending this study, they plan, build, and attempt to balance either a terrarium or aquarium ("Genesis: The Building of an Ecosystem"). Following this, if time, space, and enthusiasm permit, the study of interrelationships can be further complicated and investigated by planning and developing a miniature ecosystem outdoors (on campus).

NOTE: The sequence of activities, if used in the order presented above, are designed to lead the student as follows: The square-foot study enables the student to visualize all the complex interdependencies present even in one square foot of earth. The student is then challenged to build his own balanced ecosystem of approximately the same dimensions (i.e. the terrarium

or aquarium). As he becomes aware of the special restrictions as well as special needs (e.g. finding mating pairs of animals, providing the necessary seasonal and climatic changes for reproduction), he may be further challenged to build an outdoor ecosystem. The problems eliminated by removing the artificial barrier are replaced by other problems arising due to lack of containment: loss of items, invasion by predators, climatic disturbances, destructive intrusion by humans. Indeed it is possible to extend the unit and center an entire ecology course around the construction, maintenance, and study of the terrariums and the outdoor ecosystem.

UNIT II SCHEDULE

Pictorial Dictionary of Ecological Terms	Activity	2 periods
An Ecosystem In One Square Foot	Activity	1 period
	Post-Activity	1 period
Genesis: The Building of An Ecosystem Part I	Pre-Activity	1 period
	Activity	3 periods
	Post-Activity	1 period
Part II	Pre-Activity	1 period
	Activity	indeterminate

SUPPLEMENTS

3. Suggested list of defined vocabulary words
4. An Ecosystem In One Square Foot - Data Sheet
5. Blueprint of My "Square-Foot" Ecosystem
6. Information Sheet on Aquariums
7. Salt Water Aquariums
8. Information Sheet on Terrariums
9. Planning For The Terrarium-Aquarium Study
10. Data Sheet for Terrarium-Aquarium Study
11. Genesis: The Building of an Ecosystem
12. Answers to Supplement # 11

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

INTRODUCTION TO ACTIVITY

Pictorial Dictionary of Ecological Terms

TIME: 2 periods

GOAL:

For students to learn essential ecological terms that enable them to read and communicate ecological information with comprehension.

INTRODUCTION:

Memorizing vocabulary words can become tedious and boring. By introducing a minimum of essential words with which the students must be familiar, in a method that is perhaps novel, it is hoped the students will learn the words without perhaps even realizing that they are. . .learning! Also, the technique employed enables the teacher to evaluate each student's actual comprehension of the words as opposed to relying on a quiz based upon rote memory which does not guarantee understanding.

MATERIALS:

many old magazines

scissors

tape, glue, or stapler

Defined vocabulary words (Supplement # 3)-1 copy/student

ACTIVITY PLANS

Pictorial Dictionary of Ecological Terms

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

TIME: 2 periods

TO THE TEACHER:

Explain the need for understanding the 'language of the ecologist'. Hand out a copy of the defined vocabulary words (Supplement # 3) and go over the 'Directions to the Student' with the class. This activity can be presented as an enjoyable alternative to the students' looking up the definitions themselves and/or taking a vocabulary quiz.

SUGGESTIONS:

1. Student involvement and competition can be stimulated by promising that only those students who do not complete the assignment in time or whose completed work is poor, will have to take a vocabulary test.

2. This entire activity can be assigned as homework or used as a classroom activity the first day (so the teacher can help the students get started) and completed as homework.

3. The bibliography contains references that would be helpful to a student who needs more information to understand a term.

STENCIL

SUPPLEMENT # 3

Defined vocabulary words

DIRECTIONS TO THE STUDENT: please cut apart the definitions, and tape, glue or staple each definition onto a piece of notebook paper. Over, under or beside each definition place a picture you have either drawn yourself or cut out of a newspaper or magazine that illustrates that definition. If necessary, draw arrows or in some way explain how the picture represents the defined vocabulary word.

DEFINITIONS:

1. ECOLOGY - the study of the relationships of living things to their environment and to each other

2. BIOSPHERE - the area in which life on our planet is possible

3. ECOSYSTEM - any stable environment in which living and non-living things interact, and in which materials are used over and over again

4. ABIOTIC FACTORS - the NON-LIVING components (parts) in an ecosystem. . . includes: soil, water, gases, temperature, light, and minerals

5. BIOTIC COMMUNITY - the LIVING organisms in an ecosystem

6. ORGANISM - any living thing, plant, or animal

7. LIMITING FACTOR - anything that is needed by an organism to survive (certain foods, climate, shelter, etc.) FOR WHICH THERE IS COMPETITION

8. HABITAT - the place where an organism lives

9. NICHE - the part an organism plays in the balance of nature; that is, what an organism does to stay alive

10. INTERRELATIONSHIP - a close connection

THE FOLLOWING ARE EXAMPLES OF INTERRELATIONSHIPS IN AN ECOSYSTEM

11. PREDATOR - an animal that stalks, kills, and eats another animal

PREY - the victim of the predator; the animal taken for food by the predator

12. SYMBIOSIS - two or more organisms of different species living together (No. 13, 14, 15 are examples of symbiosis so don't find a special picture for this)

13. COMMENSALISM - two organisms of different species living together: one of them benefits, the other is neither benefited nor harmed

14. MUTUALISM - two organisms of different species living together for mutual benefit (the benefit of both)

15. PARASITISM - one organism using another LIVING organism of a different species as a source of food; that is, the act of feeding on or in another organism to the harm of the host

PARASITE - the organism that benefits

HOST - the organism that is harmed

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

INTRODUCTION TO ACTIVITY

An Ecosystem In One Square Foot

TIME: 2 periods

GOAL:

For the students to become aware of and appreciate the intra-specific and interspecific relationships that abound on (and under) just one square foot of earth.

For students to realize that even one square foot is a complex ecosystem portraying many vital interdependencies.

For students to know that organisms depend upon each other and the abiotic factors within the ecosystem for food, shelter, and reproduction.

INTRODUCTION:

A quadrate study need not be an overwhelming undertaking: This "square-foot" study is simply a 'mini-quadrate' study which is no less complex than the typical three-square-meters study usually employed. The study site should be determined beforehand, the distance timed so that the students are assured of 20-30 minutes to analyze their square-foot, and the students forwarned so they know to dress appropriately. The title is actually misnamed (for simplicity) because the study penetrates the topsoil! The ideal study site is an old field where there are a variety of (preferably) low-growing weeds. For comparison some students could study a wooded area, but because of the size of the quadrate, the woods do not offer the quantity of organisms that a field does.

MATERIALS:

PER GROUP (2-5 students)	PER STUDENT
4 feet of string	pencil
spoon (optional)	field data sheet - Supplement # 4
TEACHER	
whistle	

ACTIVITY PLANS

An Ecosystem In One Square Foot

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

TIME: 1-2 periods

TO THE TEACHER:

Divide the class into groups. Distribute a copy of the data sheet (Supplement # 4) to each student, a length of string to each group; make certain that each student has a pencil. Then lead the students to the study area. The directions on the data sheet should be self-explanatory. However, teacher assistance is always required. If the students are not allowed to spread out too much, and a reasonable group size is chosen (4), there should be ample time to visit each group, offering suggestions and posing as well as answering questions. The whistle is a convenient method for signalling the time to return.

SUGGESTIONS:

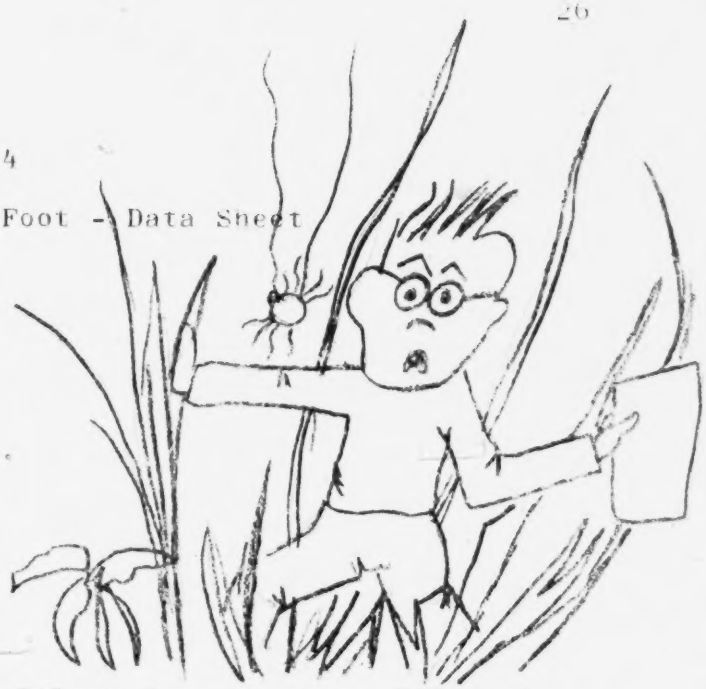
1. It is helpful to collect the data sheets that day. Reading over the data sheets will give you some insight concerning the students' level of understanding and suggest possible topics that need to be discussed.

2. Teachers with large class loads can expedite their <u>own</u> homework by requesting only one data sheet per group.

STENCIL

SUPPLEMENT # 4

An Ecosystem In One Square Foot - Data Sheet



DIRECTIONS: Lay out a "square foot of ground" using a piece of string. Explore and record the many forms of plant and animal life found in the square foot. Names or descriptions (a drawing will be ok) may be of use. Don't forget to use your senses (smell, taste, sight, hearing, touching). You must be very observant.

I. Fill in the following chart.

Column 1	Column 2	Column 3	Column 4
Name of each item: object, plant, or animal (a drawing will be ok) you find in your square foot. This includes every different thing you find on the ground and under the ground.	Is it living (biotic) or non-living (abiotic) or dead?	Needs for life that are found in the square foot. EXAMPLE feeds on a plant (grass), feeds on an insect (grasshopper), needs soil for a home, needs the moisture in the area, needs shade, needs a cool area, needs a sunny area, etc. NOTE: Leave this column blank if the item is abiotic or dead.	Job or niche of the object, animal, or plant in the "square foot" EXAMPLE: breaks up soil, holds soil in place, gives minerals, holds in water, serves as food, feeds on insects or dead materials, enriches soil, etc.
Item 1			
Item 2			
Item 3			
Item 4			

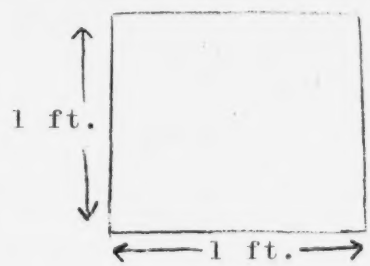
(Use back if you need more space)

Supplement # 4 (Cont.)

II. Evidence that another animal (other than man) has been present in the square foot. Example: a track, a broken twig, chewed leaves of a plant, a burrow, droppings, mounds, tunnels, tooth or claw marks, etc. . .

Evidence that man has been present in the square foot. Example: piece of glass, metal can, a nail, a bottle cap, piece of paper, etc. . .

III. Sketch the location of each object, plant or animal as you find it in the square foot.



IV. Which objects, plants, or animals observed would you wish to investigate further, and why?

POST-ACTIVITY PLANS

An Ecosystem In One Square Foot

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

TIME: 1 period

TO THE TEACHER:

Before class draw the blueprint shown in Supplement # 5 on the board or overhead projector. Ask the students to refer to their data sheet from the quadrant study (Supplement # 4). Provide each student (or group) with a copy of Supplement # 5: "Blueprint of my Square-Foot Ecosystem". Go over the directions dealing with the blueprint, pointing out that they are to use the data they collected in the field to prepare the blueprint. You may contrast this blueprint which really refers to <u>niche</u> (column 3 and 4 on their data sheet) with the sketch of their quadrant (III on their data sheet) which is a blueprint of <u>habitats</u>. After allowing adequate time for completing the blueprint and assisting as necessary, share the students' results by letting them write their examples on the board or overhead projector. Discuss responses to the statement "Things Cannot Live Alone". Be certain that students have not simply rephrased the quote. Ask <u>why</u> organisms cannot live alone; that is, what do organisms need from their environment.

SUGGESTIONS:

1. Questions:
   a. Notice the 4 arrows pointing out from the center. To what should these arrows connect?
   b. [To lead into the next activity] Do you think you could take one-square foot of soil (or water) and build a balanced, self-sufficient ecosystem? Would you like to try?

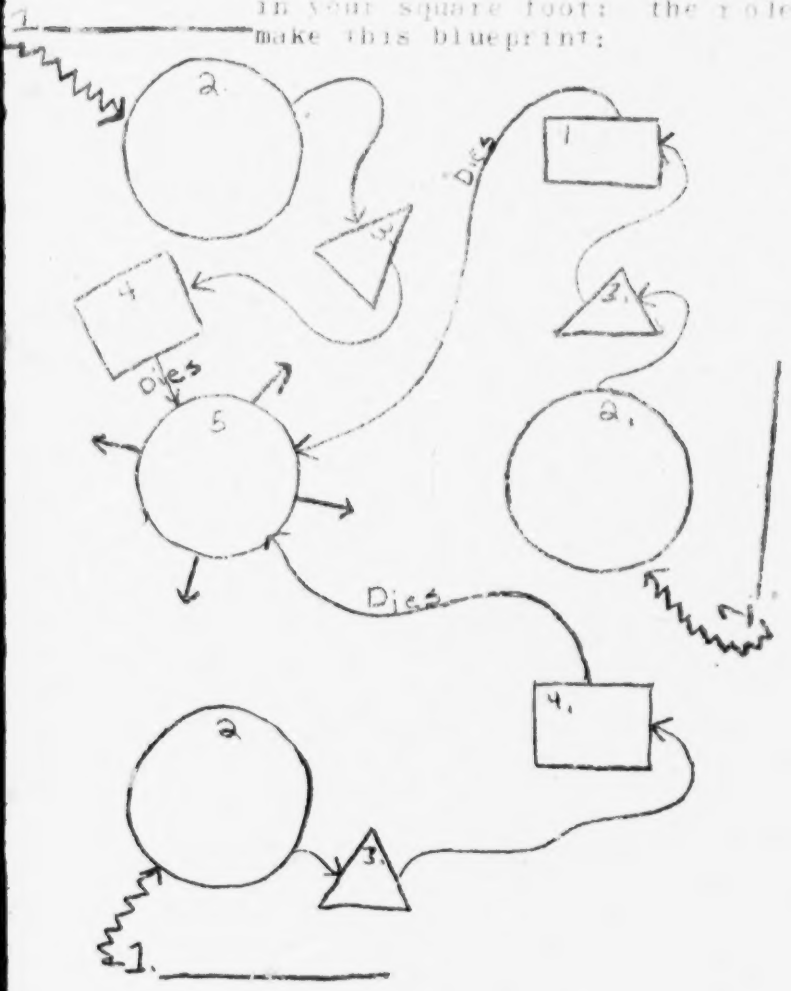
2. If a student has formed a sequence of interrelationships that actually represents a food chain, this term can be discussed.

STENCIL

SUPPLEMENT # 3

Blueprint Of My Square-Foot Ecosystem

DIRECTIONS: On your field data sheet you have already made a sketch of your eco system. You could call that sketch a blueprint of habitats. This is a diagram that shows where all the organisms live. NOW - Let's see if you can make a different kind of blueprint. A blueprint that shows the niche for each of the organisms in your square foot: the role each plays in the ecosystem. Here's how you make this blueprint:



REFER TO YOUR DATA SHEET FROM THE FIELD STUDY AND FOLLOW THE DIRECTIONS BELOW.

1. Write beside each 'no. 1', a different abiotic factor (sun, oxygen, water dirt, etc.) present in, on, or above your square-foot ecosystem. Look at one of these first and follow the arrows to '2', '3', '4', & like this:

(2) Write in the circle some living thing in your square foot that depends directly on the non living thing you wrote on no. 1.

△ Write in the triangle, some living thing in your square-foot that depends directly on what you wrote in the circle

▱ Write in the square some living thing in your square-foot that depends on what you wrote in the triangle

(5) Write in the center ('5') the microscopic organisms in your square-foot that feeds on 2, 3, and 4 after they've died.

NOW WRITE THE OTHER 3 CHAINS THE SAME WAY.

CONCLUSION

In no more than 20 words, support or reject this statement: "THINGS CANNOT LIVE ALONE".

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

INTRODUCTION TO ACTIVITY

Genesis: The Building of an Ecosystem

TIME: Part I, 5 periods
Part II, indefinite

GOAL:

For students to construct miniature balanced ecosystems that will help them comprehend the following concepts: limiting factors impinge on the survival of all organisms; all organisms are interdependent and dependent upon their physical environment; environments are constantly changing, due to both physical and biological influences (stresses); all organisms continuously alter their own environment making it less inhabitable for themselves but perhaps more inhabitable for other species; organisms that cannot adapt to change die; life on earth depends upon solar energy; the matter in an ecosystem cycles.

INTRODUCTION

Part I, the building of miniature ecosystems (i.e, terrariums and aquariums), only takes two or three days. But depending upon the discussions that develop over the weeks as some ecosystems fail and others succeed (all of them ever changing) this activity can pervade the entire course, allowing time for observation and brief discussions as events within the ecosystems occur. So many concepts, principles, and facts are demonstrated by these 'mini-systems' that it may be worthwhile for the teacher to look at the students' projects once a week in search of ideas and happenings to share with the classes.

Part II, designing and building a nature-study area on the school's campus is an extension of Part I and is suggested

for those classes or small groups that are willing to spend the extra time and effort. No time limit is indicated because this activity would naturally develop in a pattern unique to each situation.

MATERIALS (For Part I)

PER GROUP (1-5 students)

aquarium or large widemouthed glass jar

plastic wrap or other cover suitable for sealing the top or opening of the terrarium or aquarium

tape

spoon or trowel for digging

plastic bags or jars for collecting soil, organisms

PER STUDENT

Supplements # 6, 7, 8, 9, 10, 11

PRE-ACTIVITY PLANS

Genesis: The Building of an Ecosystem (Part I)

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

TIME: 1 period

TO THE TEACHER:

Divide the class into groups. Introduce the activity, relating the building of a small ecosystem to the prior study of a natural square-foot ecosystem. Discuss problems that will undoubtedly occur as (a) suggested consumers are added to the terrarium (providing ample natural food sources), and (b) the system is sealed off. Decide on the appropriate types of vessels to contain the system (cafeterias and restaurants can provide you with large screw-capped glass jars).

Give all students a copy of Supplements # 6, 7, and 8 and recommend they read these before they begin planning. Then hand each student a copy of Supplement # 9. Instruct them to decide as a group what materials they need and bring these to school the next day.

SUGGESTIONS:

If students lack initiative and/or the ability to obtain an aquarium or jar, the teacher can collect glass jars from the school cafeteria prior to the initiation of this activity.

STENCIL

SUPPLEMENT # 6

Information Sheet on Aquariums

FRESH WATER AQUARIUMS

Before starting the aquarium, make sure that the tank is waterproof. Fill it and let it stand overnight. Then place the aquarium in its permanent location and set out to equip it with a sandy bottom, water, water plants, and animal life. Place the aquarium where the temperature will be fairly constant: 60 to 70 degrees is ideal. A certain amount of light is necessary, especially if you intend to have plants in your aquarium. Sunlight is unnecessary; indirect light throughout the day is better. A window to the north or east is an excellent aquarium location. If exposure to daylight is not sufficient, use an electric light instead.

Wash gravel and soil thoroughly before putting into the aquarium. Then put the gravel and soil into the aquarium in such a way that it is about 2 inches thick at one end and decreases to one inch at the other end. When the gravel bottom has been firmed down, pour in the water. To prevent the water from stirring up the soil, place a piece of paper or a saucer on top of the gravel, and pour the water on top of this.

Rooting plants such as eelgrass, (Vallisneria) or arrowhead, (Sagitiaria) can be used. Floating plants such as water milfoil, (Myriophyllum), or waterweed (Elodea) are also good aquarium plants. It is better to plant the aquarium when it is half full of water and then finish filling it afterwards. Leave the aquarium for a few days before putting in fish so that the water will clear and the plants will become established.

An air pump and filter can be used to keep the water clear and to make sure that the fish have plenty of oxygen in the water. Some oxygen will be produced by the plants during the

day, but both plants and fish will use oxygen at night. (Oxygen in the water is used both day and night by fish). But a naturally balanced aquarium should not have a pump.

When feeding the fish, be careful not to overfeed. Feed only once a day by sprinkling a little of the food on the water. Too much fish food left in the water will make the water cloudy and it will have to be changed often. But a naturally balanced aquarium does not need to be fed. It should be your aim to have an aquarium that will maintain itself without any water changing. Half a dozen snails in the aquarium will help to keep the water clear. These act as scavengers and eat remains of fish food and the green algae which will develop when there is too much light.

Your ultimate goal is a totally self-sufficient ecosystem!

STENCIL

SUPPLEMENT # 7

Sheet No. 2 Aquarium

Salt Water Aquarium

To establish a salt water aquarium, there are two things that must be done. First, the temperature of the water is extremely important and must be kept between 40 - 60 degrees Fahrenheit to make it as much like the ocean in temperature as possible. High temperatures also reduce the amount of oxygen dissolved in water, and the animals will suffocate. It is difficult, but not impossible, to keep the temperature low in the salt-water aquarium. This can be done by keeping the aquarium away from direct sunlight and by putting it in a pan of water. Attach burlap to three sides of the aquarium and keep it in contact with the water in the pan. This means that there must be water in the pan at all times. As the water evaporates from the burlap, it causes a cooling effect on the aquarium. If the temperature begins to rise in the summer, it is possible to cool it by floating a plastic bag of ice cubes in the water.

The second important thing that must be done is to make sure that there is plenty of oxygen for the marine organisms. This can be done by using an electrical air pump aerator which will supply oxygen to the water. The water must be filtered also to remove waste materials and keep the water from becoming polluted by the animals.

Water for the aquarium can be obtained directly from the sea, or we can mix synthetic or artificial salt water by taking tap water and adding the necessary minerals to make it as much like the natural sea water as we can. Since the water will evaporate but the minerals do not evaporate, it will be necessary to add tap water when the level gets below the water mark that you made when you first filled the aquarium. If the concentration of minerals becomes too concentrated

due to water evaporation, the marine animals will be hurt or killed. About one-fourth of the salt water should be replaced every 4-6 weeks to keep the tank from becoming contaminated.

Many plants and animals can be put in the salt water aquarium, but <u>don't</u> <u>crowd</u> the aquarium (keep the organisms small). Small crabs are easiest for the beginner who has had little or no experience with the salt water aquarium. Feed small pieces of fish, shrimp, or squid to these crabs and remove any uneaten portions immediately after feeding. Any food left in the aquarium will decay and contaminate the water.

STENCIL

SUPPLEMENT # 8

Information Sheet on Terrariums

A terrarium is a miniature garden of soil, plants, and small animals. Most terrariums are made in covered glass containers. Many things can be used for housing terrariums: wide-mouthed gallon jars, fish bowls, and even shoe boxes that have been made waterproof with plastic or varnish. A gallon mayonnaise jar makes a good terrarium, and this can be your private terrarium at home. All terrariums must be fairly air-tight so that the water inside cannot evaporate. Once the terrarium is completed, it will maintain itself.

There are many kinds of terrariums. A woodland terrarium is set up using a 2-inch layer of gravel in the bottom, then moist leaf mold on top of the gravel, and finally the woods plants and animals. A thin layer of green moss helps to make the terrarium beautiful, and also helps to keep moisture in the leaf mold. A few small rocks and lichen-spotted sticks can be used as a finishing touch. Place the terrarium in the cool semishade most of the time. Select small animals that can adapt to living within the environment you've created.

The bog terrarium is made by placing 2 inches of gravel in the bottom of a waterproof container (an old aquarium is especially good). The gravel is covered with 2 to 3 inches of a mixture of sand and soil, and then covered with wet sphagnum moss. Plants from very wet places are then planted in the terrarium. This type of terrarium's environment is good for insect-eating plants such as venus flytrap, pitcher plant, and sundew. Then small insects can be put in. This terrarium should be kept in semi-shade also.

A desert terrarium is made by covering the bottom with 2 inches of gravel, and then 2 or 3 inches of sand and soil. Cactus, and other desert plants can be planted in this terrarium. Place this terrarium, uncovered, in a sunny location and

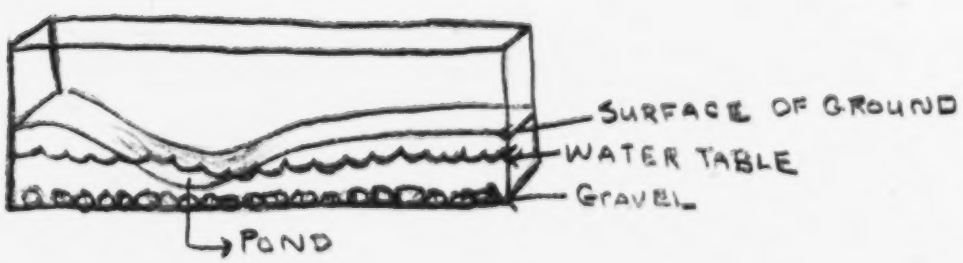
sprinkle the ground around the plants with water every ten days or so.

A survey terrarium provides an opportunity for a thorough survey of the small plants and animals of a given area. To make this type, cover the bottom with 1 inch of gravel. Place on top of this a 3-inch thick sod of grass, or piece of forest carpet, cut to the size of the terrarium. Make every effort to keep the sod intact while putting it in. Sprinkle it thoroughly with water, cover and keep it in semi-shade in a fairly cool spot. See what develops. Much animal life will be discovered. Keep a record of the insects such as spiders, mites, and others that may emerge.

In the beginning, you may have to open and close the terrarium (adding more water, or evaporating some of the water) until the moisture content is ideal. Wait until the plants are established before adding insects.

It is most important that you find out - and provide - what each animal needs to survive before you add the animals to the terrarium.

A <u>natural</u> pond can be built by making part of the land lower than the water table:



STENCIL

SUPPLEMENT # 9

Planning For the Terrarium-Aquarium Study

1. First things first! What will we learn by <u>making</u> and studying either a terrarium or aquarium? Before you can even BEGIN to make one and study it, list as many reasons as you can think of for making this study. We'll have you answer the same question again after you've studied your terrarium or aquarium for a couple of weeks.

2. NOW! Plan ahead.
   A. Make a list of everyone in your group:

   B. Read over the study sheets on terrariums and aquariums. For more information and ideas use the library books. Take notes.

   C. As a group decide what kind of terrarium you will make; will you use a box, glass jar, aquarium,. . .? Do you want to make a woodland, bog, desert, or survey terrarium? Or do you want to make an aquarium? (No pumps allowed; must be NATURALLY BALANCED!) Sketch a diagram of the ecosystem here and <u>describe</u> how you'll make it.

   D. Make a list of all materials you'll need to make it. Write down WHO will bring in each item. You WILL have class time to collect plants and animals. Include building materials AND collecting tools (spoon, spade, cans to carry specimens in,. . .)

NAME	RESPONSIBILITY

3. On the data sheet keep a record of at least 3 plants or animals in your aquarium or terrarium--keep this record for at least 2 weeks, observing every other day.

ACTIVITY PLANS

Genesis: The Building of an Ecosystem (Part 1)

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

TIME: 2-4 periods

TO THE TEACHER:

The students may be taken out as a class to collect organisms and soil or allowed to go out independently as necessary. The latter is recommended if the students can be trusted and the administration can be convinced! As the students begin to have some extra time or as they begin to complete their systems, make Supplements # 10 and 11 available. Supplement # 10 is the scientific way to maintain a record of what changes take place in the ecosystem. Supplement # 11 should help the students understand the interaction between physical and biological factors within the ecosystem they have constructed.

STENCIL

SUPPLEMENT # 10

Data Sheet For Aquarium - Terrarium Study

NAME OF AREA SPECIMENS COLLECTED FROM _____

DATE FIRST SPECIMENS WERE ADDED _____

DATE LAST SPECIMENS WERE ADDED _____

NAME and/or SKETCH OF ORGANISM	DATE OF OBSERVATION	DESCRIPTION OF ITS CONDITION	COMMENTS (did you add water? etc.)
1.	1.		
	2.		
	3.		
	4.		
	5.		
	6.		
	7.		
2.	1.		
	2.		
	3.		
	4.		
	5.		
	6.		
	7.		
3.	1.		
	2.		
	3.		
	4.		
	5.		
	6.		
	7.		

STENCIL

SUPPLEMENT # 11

Genesis: The Building Of An Ecosystem

One little square foot of earth. . . looks pretty uncomplicated at first glance. BUT! By now you realize there's a lot of activity going on there! And to start out with a square foot or so of empty space with walls and fill it in with a combination of organisms and abiotic components that are warm and alive, throbbing with activity--how very complicated that would be! And this is exactly what you are attempting. You know, it's going to require more than good luck to make your terrarium (or aquarium) succeed. So the following questions have been posed to help you 'think through' the building of your own ecosystem.

(please answer these on a separate sheet of paper-write the questions, then the answer)

A. WATER CYCLE

1. Where does the moisture that condenses on the walls and roof of the terrarium come from?
2. How do plants obtain water once the terrarium is sealed?
3. How do your animals in the terrarium obtain water? (the method varies)
4. What happens to the water that has condensed on the walls of the terrarium?
5. If there is insufficient (not enough) water in the terrarium, what would you expect to happen?
6. If there is too much water, what would you expect to happen?
7. Why is gravel placed in the bottom of a terrarium?

B. REUSE OF MATTER (of nutrients)

8. Explain how plants would be fertilized in a sealed terrarium.
9. Would you need to have bacteria and fungi in the terrarium? Why-or-why not?
10. List everything you would need to have in a balanced terrarium that contained a mouse to: (a) supply the mouse with food, and (b) take care of the mouse's wastes.
11. List <u>everything</u> you would need to have in a balanced terrarium to support a praying mantis.

C. OXYGEN-CARBON DIOXIDE CYCLE

12. Why can plants survive in a sealed terrarium without animals? How do they obtain carbon dioxide and nutrients for photosynthesis?
13. How do animals obtain oxygen in a sealed terrarium?

D. ANALYZING YOUR OWN TERRARIUM

14. Write down everything you have in your terrarium that is alive. Beside it (each one) list all the things it needs to survive. Then place a check over these needs as you provide them.

For example:

ORGANISM	NEEDS
1. spider	objects to spin a web on, insects to eat, plants to supply it with oxygen, bacteria to decompose its waste, soil and water for its plants to grow on, food for its prey so the prey can multiply

TEACHER SUPPLEMENT # 12

ANSWERS TO SUPPLEMENT # 11, "THE BUILDING OF AN ECOSYSTEM"

1. From plants (through the leaves), animals (breathing, perspiring, excreting their wastes), the soil, the air It's cool on the walls so the water vapor condenses.

2. See no. 1. (it's the water cycle: evaporation - condensation - precipitation)

3. From the plants and animals they eat, the moisture on the walls, a pond if you have one, the damp soil, dew on the plants

4. It runs down or falls down and is absorbed by the soil to be used by plants and animals. If it's warm, it may evaporate into the air again.

5. Some things may die, leaving more water for others. Some may adapt to less water. For example, bacteria and algae form <u>spores</u> while protozoa form <u>cysts</u>. Seeds can remain dormant (inactive) for hundreds of years. Some may die.

6. Many things may drown, plants rot, mold and mildew will grow on everything. See no. 7.

7. For drainage of excess water, to provide habitat for some organisms, to store water

8. Animal wastes, dead plants and animals that decay, dead leaves and rotting wood

9. <u>Yes</u> - they decompose (decay, rot) the items listed in no. 8 above

10. (a) Lots of grain to eat and sun, soil, water to grow the grain, reproduction of the grain, water to drink

    (b) bacteria and lots of space (it takes a <u>long time</u> for wastes to decay)

11. <u>Lots</u> of insects to eat and the necessary food and habitats and shelter and mates for these insects to live and <u>reproduce</u>
    water to drink
    bacteria to decompose wastes

12. Plants produce their own carbon dioxide (by the process of respiration)

13. Plants produce oxygen as a waste gas after photosynthesis

POST-ACTIVITY PLANS

Genesis: The Building of an Ecosystem (Part I)

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

TIME: 2 periods followed by 5-10 minutes, once or twice a week for the remainder of the course

TO THE TEACHER:

1. Discuss the answers to the questions in Supplement # 11.
2. Discuss changes that are taking place in the ecosystems.
3. Encourage students to continue their observations beyond the required seven observations.
4. Refer to individual ecosystems occasionally, discussing with individuals and with the class probable explanations for observed changes. Utilize these ecosystems whenever they demonstrate concepts or principles being studied.

PRE-ACTIVITY PLANS

Genesis: The Building of an Ecosystem (Part II)

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

TIME: 1 period

TO THE TEACHER:

If students are interested and willing to obtain the plants, plan for the construction of an ecosystem somewhere on the school's campus. Decide on the kind of community desired: woods, open field, or even a garden. Also decide on where and how organisms will be obtained. Perhaps this project can develop into a nature study area!

ACTIVITY PLANS

Genesis: The Building of an Ecosystem (Part II)

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

TIME: Indefinite (may involve students after school or during lunch)

TO THE TEACHER:

Students can either devote class time or after-school hours constructing the ecosystem. Habitats should be discussed: which plants are shade-tolerant, which organisms require a lot of water, what producers are necessary for supporting the consumers, how will the necessary abiotic factors be provided for organisms.

POST-ACTIVITY PLANS

Genesis: The Building of an Ecosystem (Part II)

UNIT II: INTRODUCTION TO INTERRELATIONSHIPS

TIME: Indefinite

TO THE TEACHER:

This type of project cannot be limited by specific time restrictions. Planting can be continued at appropriate seasons and students as well as teachers and administration can become involved. Occasionally a class period could be spent walking through the ecosystem looking for examples of interaction, interdependencies, balance and upset, followed by evaluation of the ecosystem as a functioning whole; its dependence on factors outside its physical boundary; changes that are occurring, and ideas for man-made changes.

The learning possibilities are endless and may be as nebulous and "unmeasurable" as merely a means of appreciating the dynamics of nature!

UNIT III PLAN

UNIT III TITLE: NATURE'S LAW OF SUPPLY AND DEMAND

TIME: 8 periods

PURPOSE OR OBJECTIVE:

For students to further investigate how living organisms interact with the physical factors and with each other to obtain the energy necessary for sustaining life.

For students to know that interrelationships can be represented as either a food chain, or a web of interconnecting food chains.

For students to know that solar energy is converted by producer organisms into chemical energy which is then transferred through each link in a food chain, eventually used up and lost (mainly as heat) to the environment.

For students to know that the numbers of organisms in each successive link in a food chain must decrease sharply because of the energy lost.

For students to know that poisons are concentrated in a food chain, the top carnivores accumulating the greatest amount.

ABSTRACT:

The following activities are related, with both emphasizing one of the two basic needs for life: food. The Food Web Game is primarily concerned with the complexity of dependencies within a community and the physiological ties that exist even between a producer and a top carnivore. To prepare the web, the students become representative organisms in a community and physically construct a web that binds them to each other according to what they each eat.

The second activity (The Pyramid Puzzle) stresses the dramatic loss of useable energy as it passes through a food

chain. In order to understand this abstract concept, the students actually build a pyramid symbolic of the numerical relationship of organisms at each level of a food chain. Biological concentration of poison can also be readily demonstrated.

Both activities can be varied in length depending upon how much of the preparation the students are involved in. There are numerous opportunities for demonstrating man's destructive effects on natural ecosystems by such activities as trophy-hunting, overhunting, bounty-hunting, and use of persistent pesticides, and other biologically concentrated poisons.

UNIT III SCHEDULE

The Food Web Game	Pre-Activity	2 periods
	Activity and Post-Activity	1 period
The Pyramid Puzzle	Pre-Activity	2 periods
	Activity	1½ periods
	Post-Activity	1½ periods

SUPPLEMENTS

13. Words To Know - Food Chains And Energy Flow
14. One Food Chain Of An Open Field Community
15. Food Web Of A Forest Community
16. Open Field Community
17. Key To Food Webs
18. Suggestions For Utilizing The "Key To Food Webs"
19. Food Web Of A Marine Community
20. Food Web Of An Arctic Community
21. Directions For Making The Pyramid
22. Examples Of Food Chains
23. Energy
24. Answers To Supplement # 23
25. Nature's Law Of Supply And Demand (test)
26. Answers To Supplement # 25

UNIT III: NATURE'S LAW OF SUPPLY AND DEMAND

INTRODUCTION TO ACTIVITY

The Food Web Entanglement

TIME: 3 periods

GOAL:

To construct a food web that will represent the complex interdependencies of living organisms in terms of food and to extend this concept so that the effects of specific stresses (natural and man induced) on a community can be observed.

INTRODUCTION:

Since food webs are extremely complex, it seems appropriate to discuss the effects of changes in a community that affect food webs in a physically complex manner. The students, therefore, are entangled with yarn or string and asked seemingly simple questions, only to find the answers in a hopelessly tangled web of their own making!

MATERIALS: *refer to preactivity material

several balls of knitting yarn, or string
scissors
construction paper cut in 5" squares; one per student
felt-tip markers or crayons
references for preparing food webs (if students do this)
2 large paper clips per student
50 2-inch squares of black paper
*One Food Chain of an Open Field Community - Supplement # 14
*Words to Know - Supplement # 13
*Food Web of a Forest Community - Supplement # 15
*Food Web of an Open Field Community - Supplement # 16
*Key to Food Webs - Supplement # 17

*Suggestions for using the "Key To Food Webs" - Teacher Supplement # 18
Food Web of a Marine Community - Teacher Supplement # 19
Food Web of an Arctic Community - Teacher Supplement # 20
*Cards, approximately 6" x 2" with each of the following on a separate card: grass, grasshopper, rabbit, caterpillar, blue jay, clover, sycamore tree, earthworm, owl, snake, robin, praying mantis, hawk, vulture, bacteria, fungi
*tape for cards (above)

PRE-ACTIVITY PLANS

The Food Web Entanglement

UNIT III: NATURE'S LAW OF SUPPLY AND DEMAND

TIME: 2 periods (or 4 periods if students made their own cards)

TO THE TEACHER:

The following are suggested approaches to introducing the concept of food chains leading to an understanding of food webs.

A. Introduce terms used in the study of food chains: Supplement # 13. Then ask students to label the organisms in their "Blueprint of My Square Foot" (Supplement # 5), using the terms.

B. Discuss food chain relationships among the organisms in the terrarium and aquariums that were established in unit II. Ask each student to write one food chain present in his terrarium.

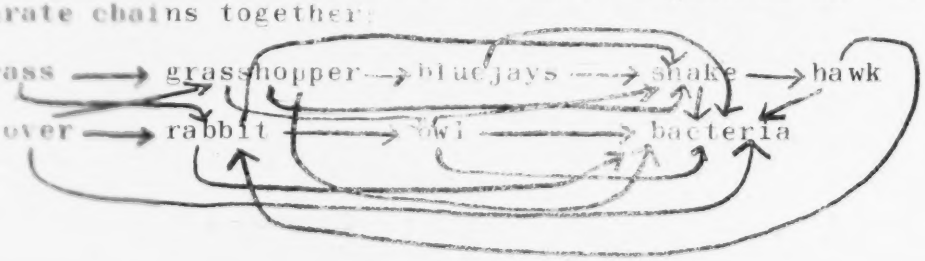
C. The students can see the role played by decomposers if some hamburger (one portion kept wet, the other dry) is placed in a warm area for a week, and the ensuing putrefaction discussed.

D. Give each student a copy of "One Food Chain of an Open Field Community" (Supplement # 14). Note factors omitted such as the original energy source (sun) and the niche that makes the chain a cycle (decomposers). Then let students write in the terms for the forest community.

E. Now introduce the concept of a food web. Distribute the small cards, each with the name of a different organism (see bottom of list of materials). Ask for one student holding a producer to tape his card on the board and draw an arrow after it. Then call for a herbivore. Continue this through a <u>single</u> food chain. Below this food chain begin another separate chain. Continue until all cards are used. Ask the students if the chains would exist as separate entities in a natural community. Then ask students to draw arrows across chains that connect organisms in separate chains together:

Chain 1: grass → grasshopper → bluejays → snake → hawk

Chain 2: clover → rabbit → owl → bacteria



Students will realize that the true relationship of organisms in a community does not express itself in a simple chain. Ask them to give the new structure a more accurate name than "chain". They may say it looks like a web!

F. Students can establish two food webs, using Supplements # 15 and # 16 (and Supplement # 17, if necessary).

The following suggestions can be omitted if the teacher prepares the "niche cards" (Supplements # 19 and # 20) himself.

1. Students and teacher list examples of as many communities as they can think of: marine, forest, pond, arctic, tundra, marsh, subtropic, tropic, ditch, desert. As a class, decide on one community to study.

2. Each student chooses to represent either a producer, primary-secondary-tertiary consumer, or decomposer, assuring ample representation at each trophic level.

3. Remaining confined to the one community agreed upon, students representing each trophic level (above) work together to avoid repetition. Each student decides on one organism, sketches it on a 5" square piece of poster paper, and writes everything that organism can eat on the card. (Supplement # 19)

STENCIL

SUPPLEMENT # 13

Words To Know - Food Chains And Energy Flow

1. Producer - an organism that uses the energy of sunlight to make its own food from simple substances like carbon dioxide and water (EX: green plants, algae)

2. Herbivore or Primary consumer - an animal that eats plants (EX: cow, sheep)

3. First level carnivore or Secondary consumer - animal that eats herbivores

4. Second level carnivore or Tertiary consumer - animal that eats the first level carnivores

5. Top carnivore - the animal that is at the end of a food chain and has few if any predators (EX: man, hawks)

6. Omnivore - an animal that eats plants or animals (EX: bear)

7. Scavenger - an animal that eats animal wastes and dead bodies of animals not killed by itself (EX: vulture, crab)

8. Decomposer - an organism that feeds on animal wastes and dead plants and animals, breaking them down into simple materials that can be used by green plants (EX: bacteria, fungi)

9. Food Chain - a chain of organisms that depend on each other for food, beginning with plants, and ending with top carnivores

10. Food Web - all the interconnecting food chains in a community

11. Food pyramid - a way of showing the amounts of food needed in a food chain

12. Saprophyte - a plant that cannot make its own food (no chlorophyll) and so obtains it's food from dead and decaying organisms (EX: fungi, mushrooms)

13. Niche - the role an organism plays in an ecosystem; an organism's place in a food chain

14. Plankton - the floating or weakly swimming animals and plants in a body of water, often microscopic (EX: protozoa, algae)

15. Phytoplankton - plant plankton (EX: diatons, algae) Ocean phytoplankton produce most of the oxygen on earth.

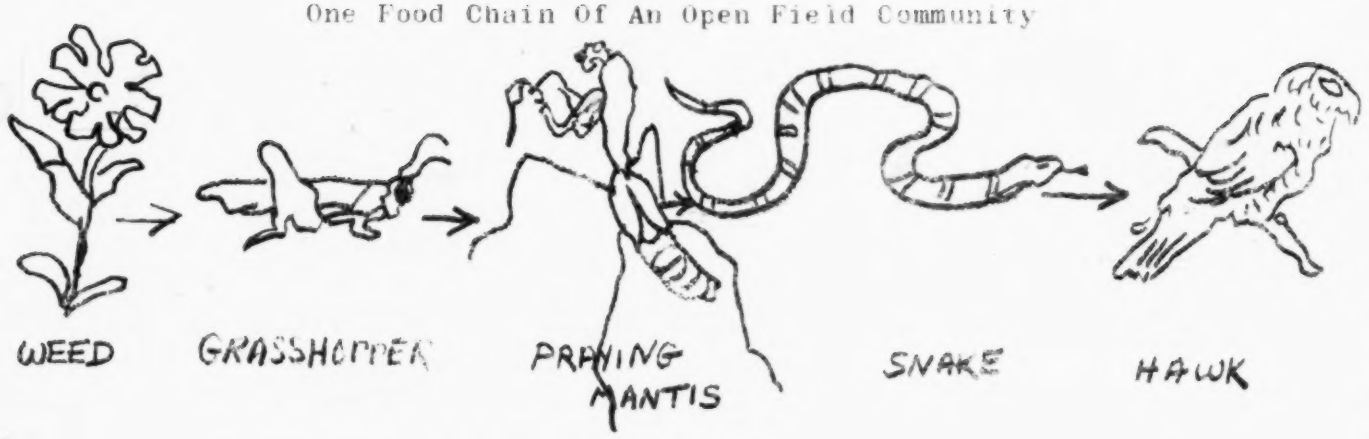
16. Zooplankton - animal plankton (EX: protozoa)

17. Symbiosis - the living together of 2 or more organisms <u>OF A DIFFERENT SPECIES</u>; this term includes: parasitism, mutualism, and commensalism

STENCIL

SUPPLEMENT # 14

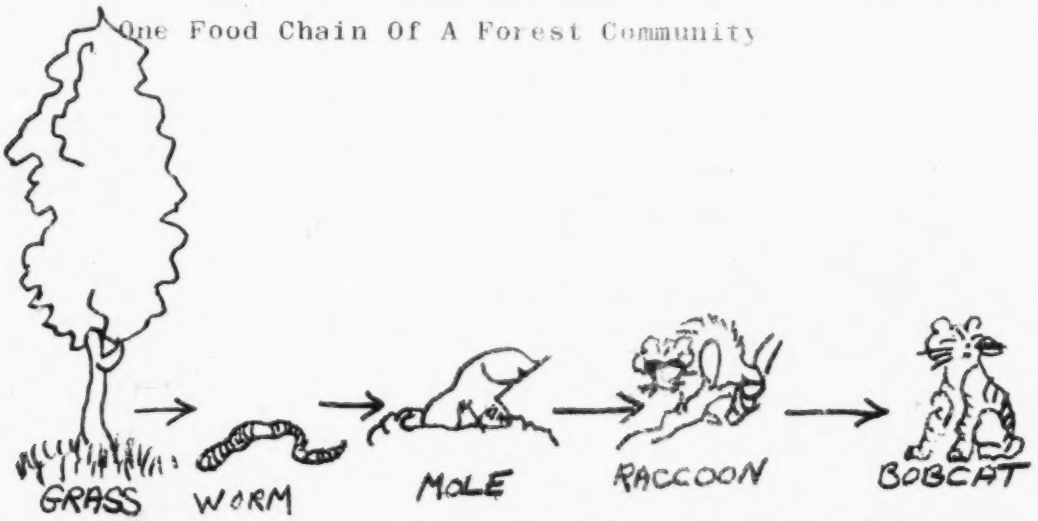
One Food Chain Of An Open Field Community



Producer | Herbivore | Primary Carnivore | Secondary Carnivore | Top Carnivore

Consumers

One Food Chain Of A Forest Community



_____ _____ _____

_____ _____ _____ _____ _____

_____

DIRECTIONS: Write in the proper terms to describe the niche for each organism in the forest food chain. Refer to the open field community for the proper terms.

STENCIL

SUPPLEMENT # 15
Food Web Of A Forest Community

DIRECTIONS: Draw the arrows showing which organisms feed on which.

Draw your own choice of organism in the forest community.

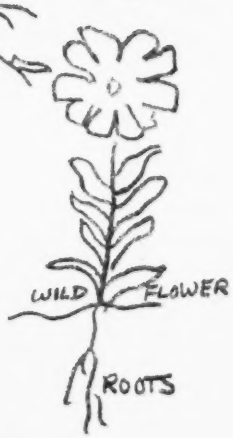
STENCIL

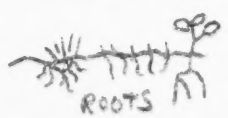
SUPPLEMENT # 16

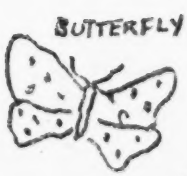
Open Field Community

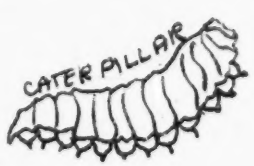
DIRECTIONS: Draw the arrows showing which organisms feed on which.

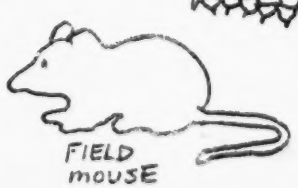
Add an organism of your own choice (that lives in an open field)











STENCIL

SUPPLEMENT # 17

Key To Food Webs

CONSUMER	NICHE (may eat the egg, young or adult)
Hawk	rabbits, insects, birds, snakes, shrew, squirrels, mice, gophers
Owl	rabbits, insects, birds, squirrels, moles, mice, hawks, shrew
Bear	nuts, seeds, fruit, porcupine, rabbit, deer, insects, mice, turtles, frogs, toads, shrew
Small birds	vary according to the type: nuts, seeds, insects, spiders, fruit, worms
Raccoon	nuts, seeds, fruit, earthworms, insects, moles, mice, turtles, frogs, toads, shrew
Bobcat	porcupines, rabbits, insects, birds, squirrels, mice, owls, raccoons, shrew
Opossum	nuts, seeds, fruit, insects, birds
Mole	seeds, herbs, earthworms, millipedes, insects, spiders, centipedes
Porcupine	bark, nuts, leaves, herbs, buds, twigs
Squirrel	bark, nuts, seeds, fungi, leaves, herbs, fern, fruit, bud, twigs
Mouse	nuts, seeds, herbs, fruit, millipedes, insects, spiders, centipedes
Wolf	mice, jack rabbits, gophers, snakes, plants
Quail (bob-white)	insects, weeds, seeds, beetles, spiders
Jack rabbit	bark, twigs, grasses, clover
Gopher	roots, bulbs, tubers
Snakes	vary according to the type: earthworms, insects, birds, moles, mice, spiders, centipedes, shrew, snakes, frogs, toads
Turtle	seeds, fungi, leaves, fruit, earthworms, insects

Supplement # 17 (Cont.)

CONSUMER	NICHE
Spider	millipedes, insects, centipedes
Tick	adults suck the blood of animals before they can change from newly hatched to nymph and then from nymphs to adult; the newly hatched and nymphs feed only on rodents and the adults feed on man and large animals
Fly	vary according to the type; the larvae and adults usually eat rotting plant and animal material; often the adult doesn't eat at all
Caterpillar	eats plants
Adult butterfly	many types don't eat (just reproduces) or may suck nectar from flowers
Termite	eat (decompose) dead wood (must have a special protozoan in their stomach to digest the cellulose in the wood for them; a good example of mutualism)
Carpenter ant,	burrow in wood but don't eat it; feeds on a sweet fluid made by aphids; also feed on a variety of foods, including insects and sweet fluids from plants
Grasshopper	grass, nuts, seeds, fungi, ferns, herbs, fruits, twigs, buds, leaves
Praying mantis	insects, millipedes, spider, centipedes, frogs, toads, other praying mantis
Lady bug beetle	both the larva and adult feed on insects, including aphids; have huge appetite
Aphid	suck the juices out of plants
Cricket	grass, herbs, seeds, fruit, dead animals, other crickets
Millipede	grass, herbs, decaying plants
Centipede	insects

Supplement # 17 (Cont.)

OTHER REFERENCES:

THE AUDUBON NATURE ENCYCLOPEDIA

*The Community of Living Things: Forest and Woodland
Field and Meadow

Teach Me About: Insects, Birds, Reptiles, Fishes, Mammals; Flash Cards By Renewal, Inc.

Golden Nature Guide To: Insects, Reptiles, Butterflies, and Moths

Peterson Field Guide To: Birds, Butterflies, Reptiles & Amphibians, Trees and Shrubs

*available from Creative Educational Society, Inc., Mankato, Minnesota. Etta Schneider, Editor in Chief.

TEACHER SUPPLEMENT # 18

Suggestions For Utilizing The "Key To Food Webs"

1. For students who are incapable of researching on their own, the list can be used to complete the "Food Web of a Forest Community" and "Food Web of an Open Field Community".

2. Students can be asked to construct food chains using the key as their reference.

3. The following questions could be asked, using the key as a reference:
   a. Which are (producers, consumers, scavengers, decomposers, carnivores, herbivores) present in a(n) (forest, open field)?

   b. Which of the animals would suffer if pesticides were sprayed on an open field?

   c. Which woodland organisms could still survive if the forest trees were all cut down? How do you know?

   d. Which organisms can adapt to either forest or open field?

   e. Which organisms depend either <u>directly</u> <u>or</u> <u>indirectly</u> on insects?

   f. Which organisms would die if someone continued to "cleanout" the forest floor (rake all dead matter away, carry out and burn all dead wood)?

4. Students who like to draw can be asked to illustrate the key.

5. Students can add more organisms to the list, including the niche of each.

6. The list could be divided into forest organisms and open field organisms.

7. The students could be asked to reorganize the list, grouping all herbivores, decomposers, or carnivores.

8. The key can be used to aid in making the "Pyramid Puzzle".

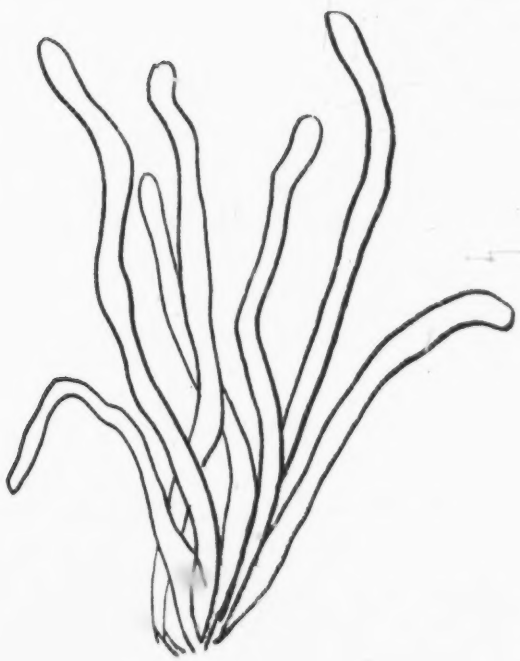
TEACHER SUPPLEMENT #19

Food Web Of A Marine Community

Directions:
Cut construction paper (different colors can be used to denote different trophic levels) or cardboard into 5" squares, one per student. Reproduce each square below on a separate card.

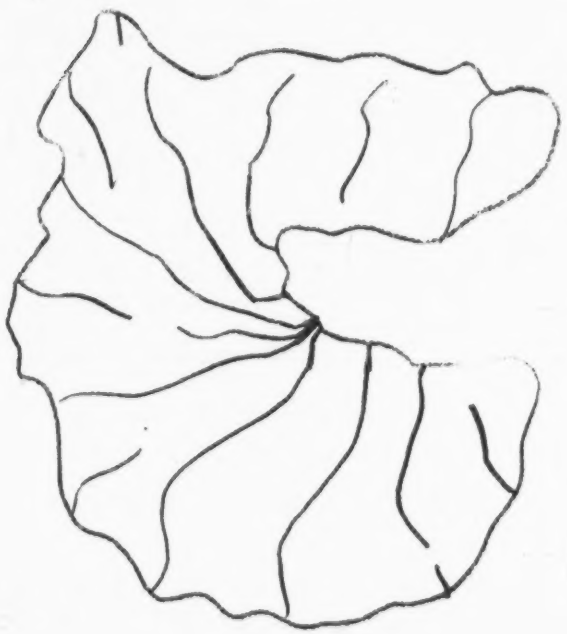
1st level

NICHE	NAME
PRODUCER	EEL GRASS (is really algae)

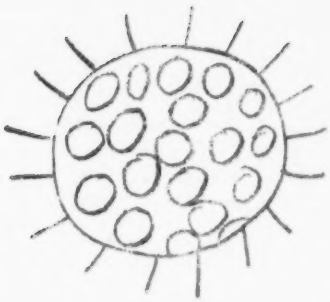


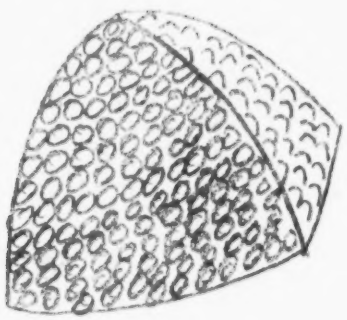
1st level

NICHE	NAME
PRODUCER	SEA LETTUCE (algae)



NICHE	NAME
PRODUCER	DIATOMS (the smallest algae-microscopic)

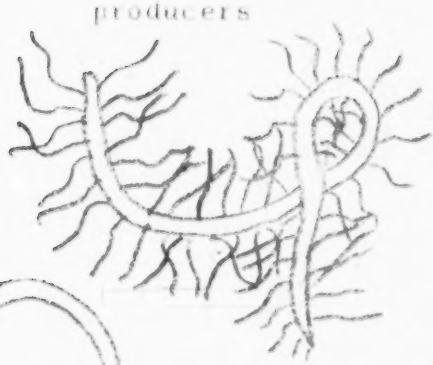




NICHE	NAME
PRODUCER	KELP (a brown alga)

2nd level

NICHE	NAME
feeds on all producers	WORMS



fringed worm 6 inches

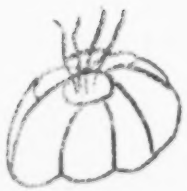
ribbon worm 20 feet long

trumpet worm 2 inches

2nd level

NICHE	NAME
eats all producers	BARNACLE (a crustacean)

brushes food into mouth

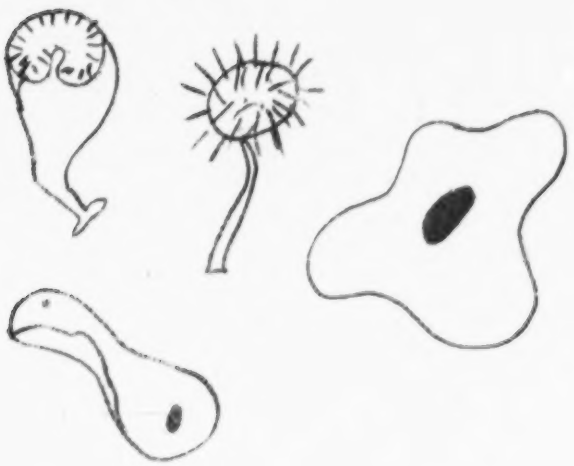


rock barnacles 2 inches

2 inches

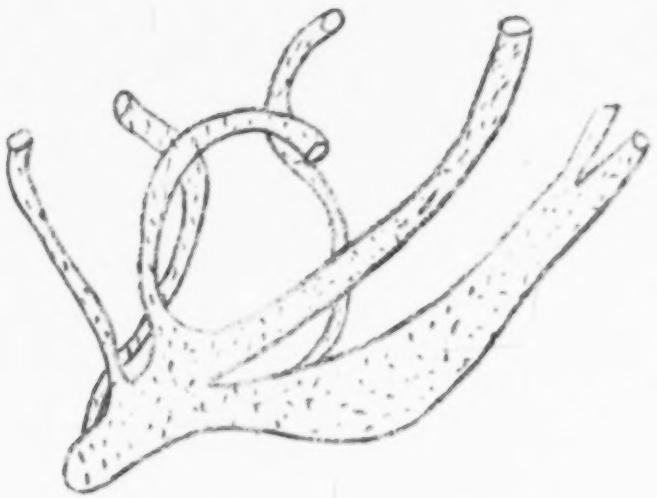
2nd level

NICHE	NAME
Feeds on all the producers	PROTOZOA



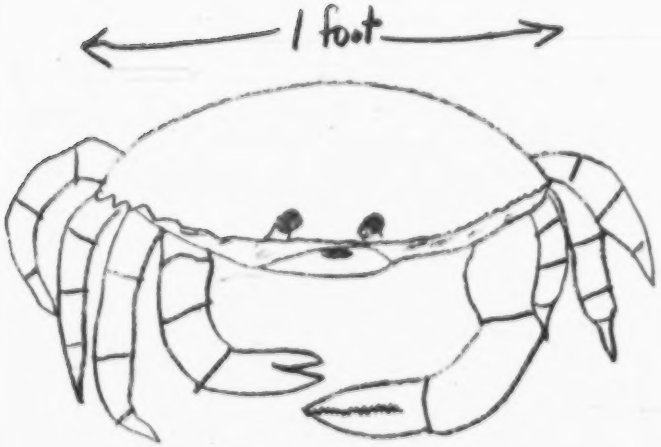
3rd level

NICHE	NAME
eats all producers. larvae, protozoa	SPONGE



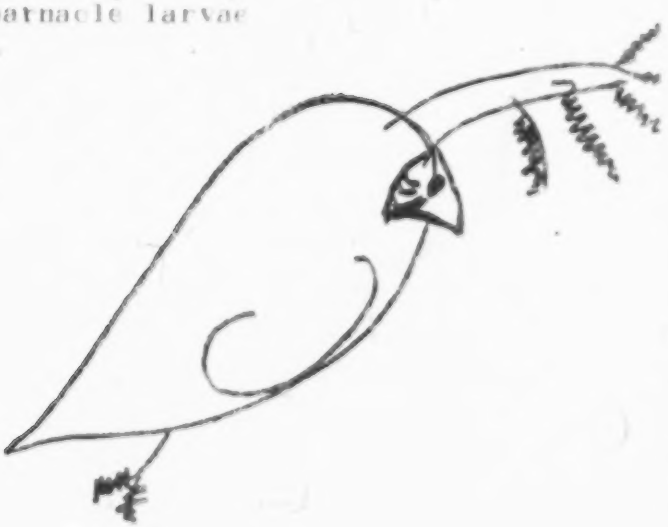
3rd level

NICHE	NAME
eats all producers protozoa, worm larvae, barnacle larvae	CRAB (a crustacean)



3rd level

NICHE	NAME
feeds on protozoa, worm larvae, diatoms, barnacle larvae	WATER FLEA (a tiny crustacean)



3rd level

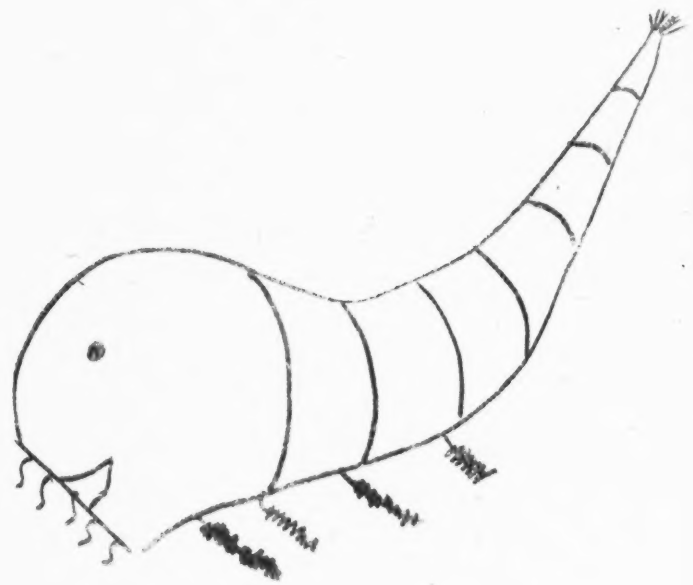
NICHE	NAME
eats all producers, larvae, barnacle larva	CLAM

Chestnut clam
½ – 2 inches

pismo clam
5 inches
(mmm. m good)

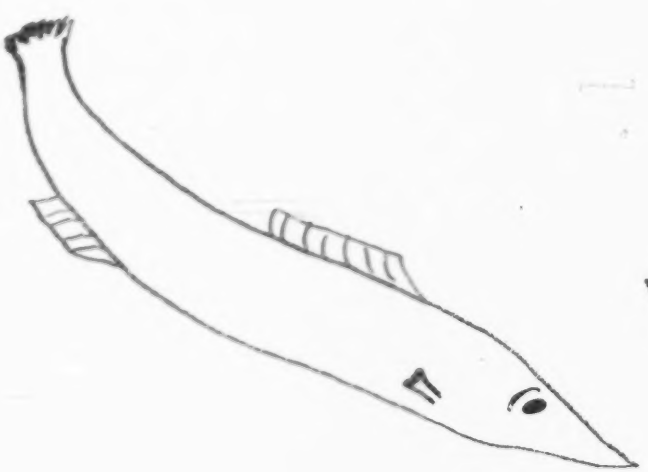
3rd level

NICHE	NAME
feeds on protozoa, worm larvae, all the producers	COPEPOD (a tiny animal) a crustacean



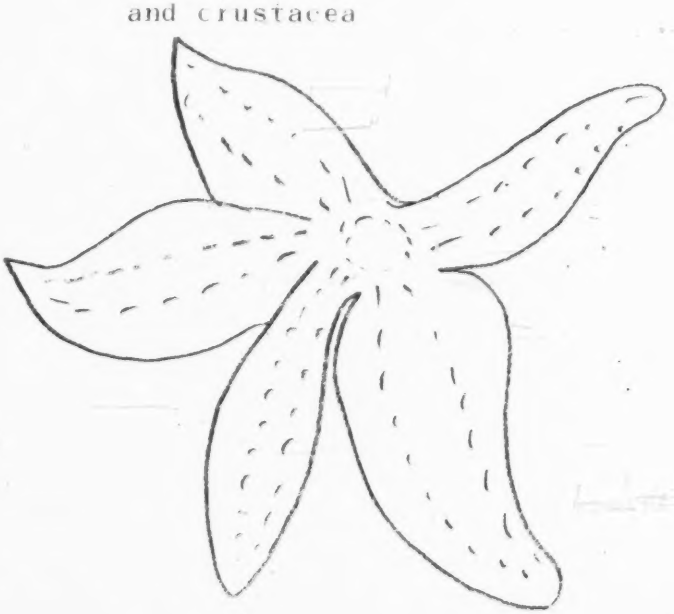
3rd level

NICHE	NAME
eats worms, water flea, protozoa, copepods, all producers	SARDINE (a small fish)



4th level

NICHE	NAME
eats all producers; protozoa; copepods; water flea; larvae of: worms, mollosks and crustacea	STARFISH



4th level

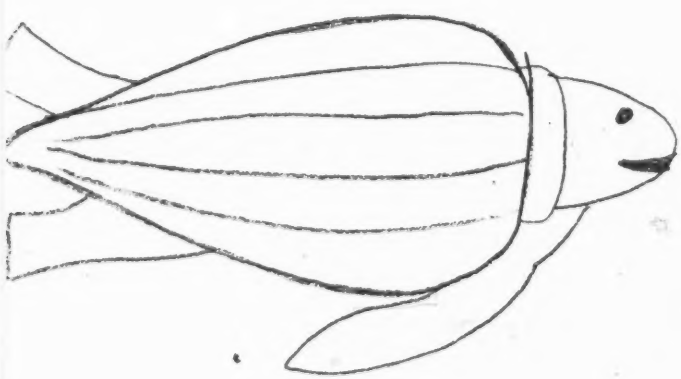
NICHE	NAME
eats producers, protozoa, copepods, water flea, mollusk larvae, crustacean larvae	BLUE WHALE

4th level

NICHE	NAME
eats sardine. herring, worms	HERON

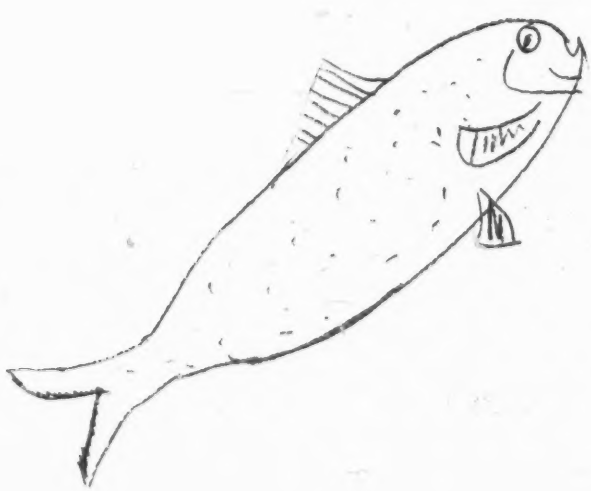
4th level

NICHE	NAME
eats producers, worms, crabs, copepods, water fleas, scallops, and clams	SEA TURTLE



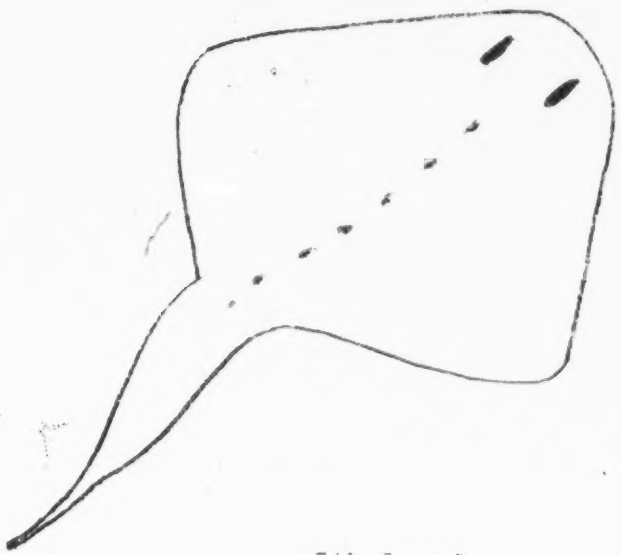
3rd level

NICHE	NAME
eats all producers, worms, copepods, protozoa, water flea, larvae of crustacea and mollusks	HERRING



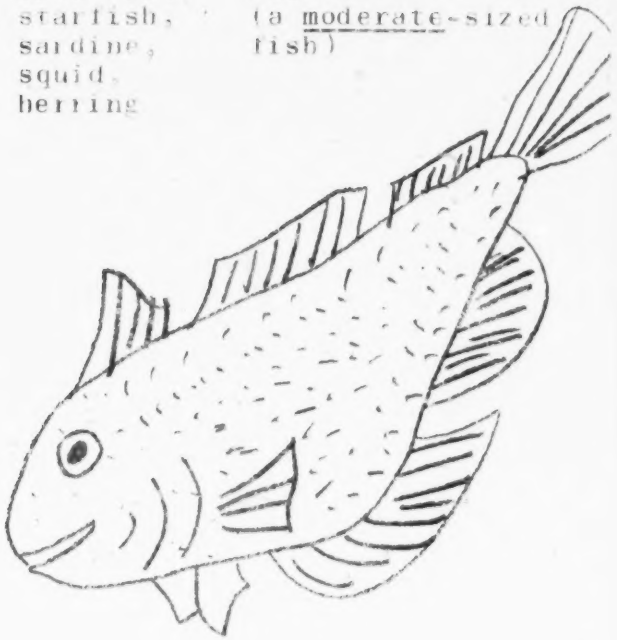
4th level

NICHE	NAME
eats small fish (like sardine, herring), starfish, crab, squid	SKATE



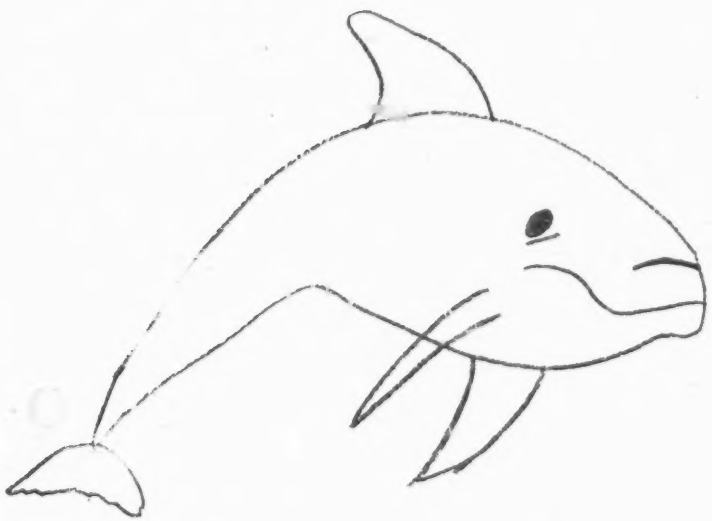
4th level

NICHE	NAME
eats crab, starfish, sardine, squid, herring	COD (a moderate-sized fish)



5th level

NICHE	NAME
eats fish, cod, sardine, herring	DOLPHIN (a mammal)

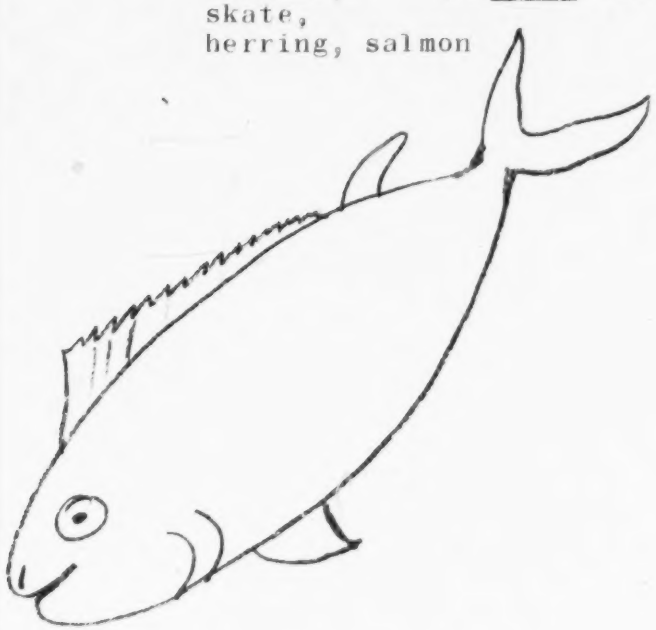


5th level

NICHE	NAME
feed on squid, crab, scallop, clam, barnacles, sardine, herring	SQUID (a mollusk)

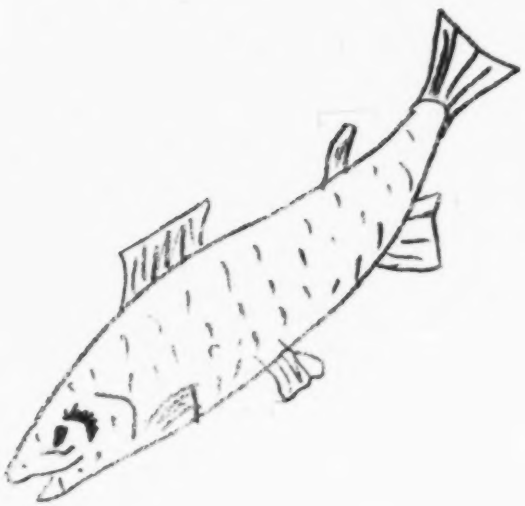
5th level

NICHE	NAME
eats cod, sardine, skate, herring, salmon	TUNA (a large fish)



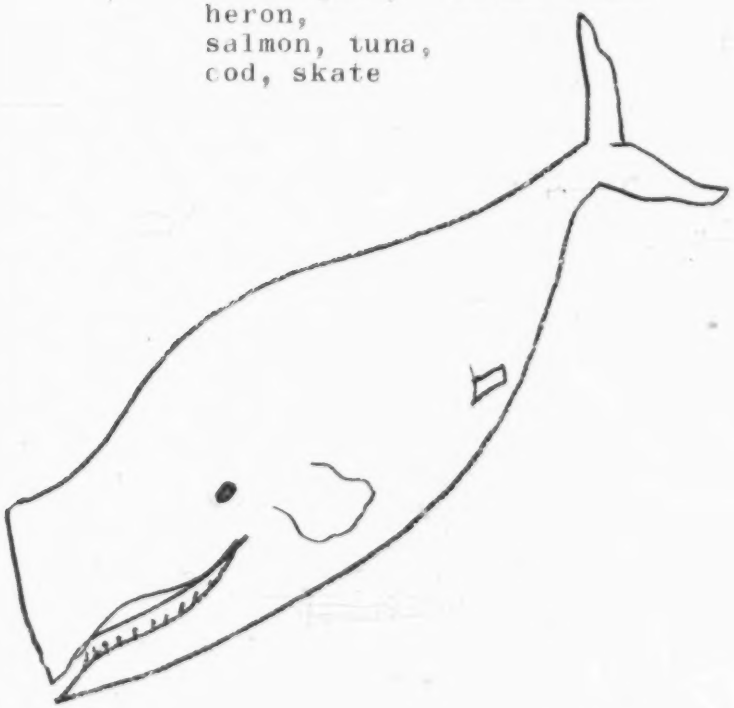
4th level

NICHE	NAME
eats sardine, herring	SALMON

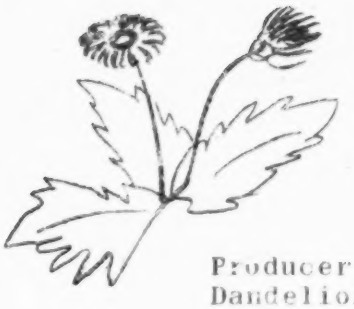


5th level

NICHE	NAME
eats squid, heron, salmon, tuna, cod, skate	SPERM WHALE



Producer : SPAINISH MOSS BROMELIACEAE
Mosses & lichens FRODUCER



Producer;
Dandelion

Producer;
Buttercup

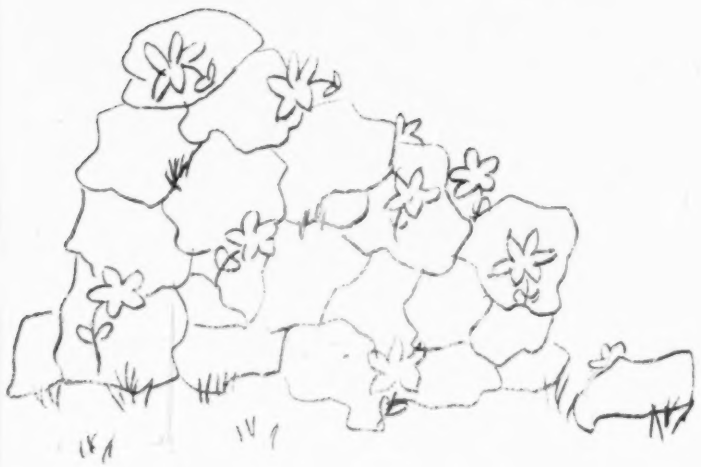
ALGAE:
producer

LICHENS
(producer)

PRODUCER
FORGET ME NOTS

Habitat: High land animal, cold, winter-like climate.
Food: Grass, leaves, minerals from salt licks, etc.

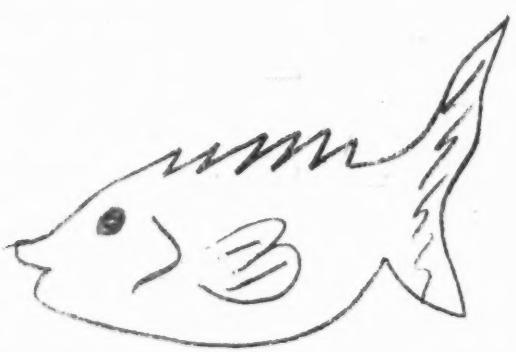
"THE ELK" 72

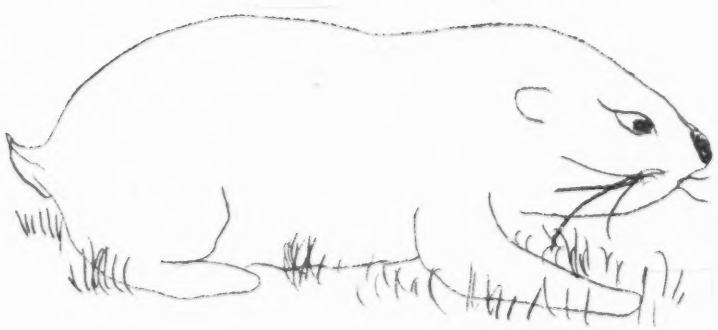


Herbivore GREENLAND COLLARD LEMMING

Food:
vegetation

BLACKFISH: algae, plankton, plants



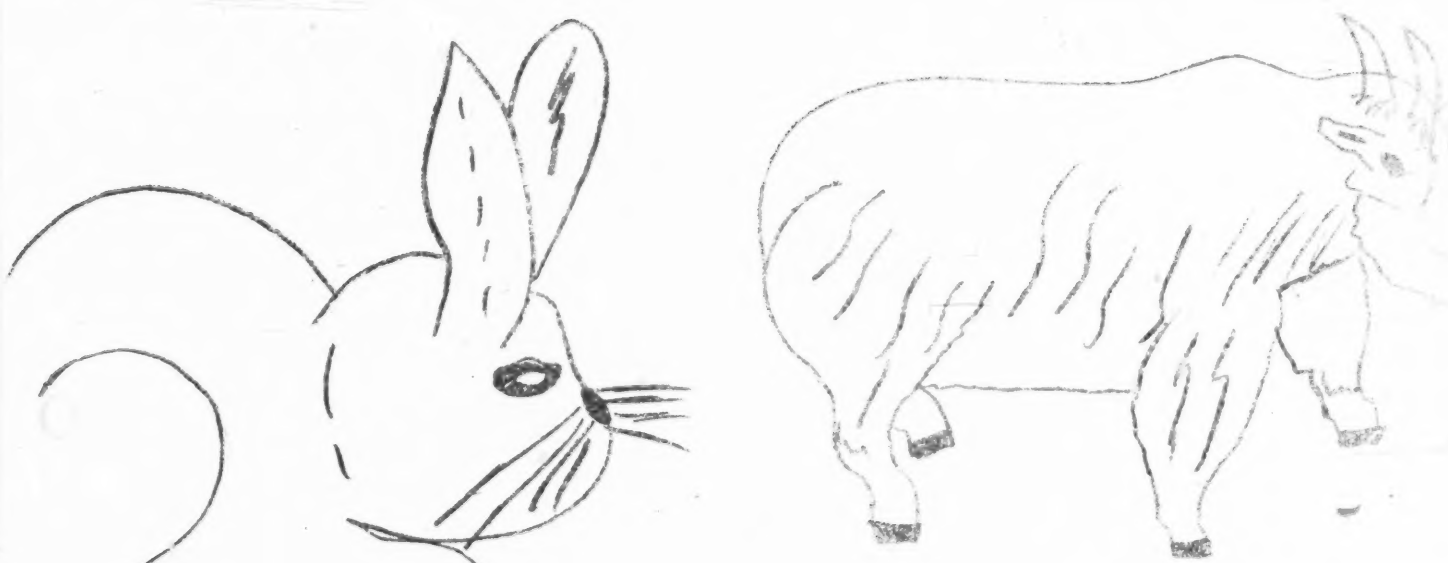


MUSK OX; Grasses, Sedges, and some leaves

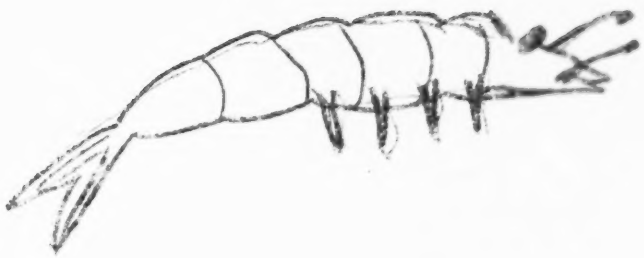
CARIBOU; grasses, sedges, willow, and birch leaves. Prefers lichens

RABBIT; twigs, bark, and leafy plants

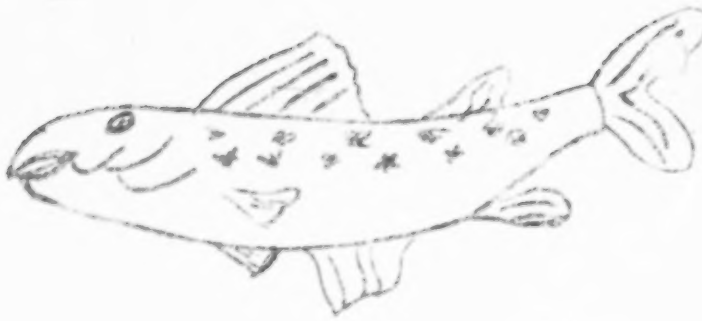
MOUNTAIN LION; variety of alpine plants and minerals



SHRIMP (Shellfish)
eats. algae, plankton

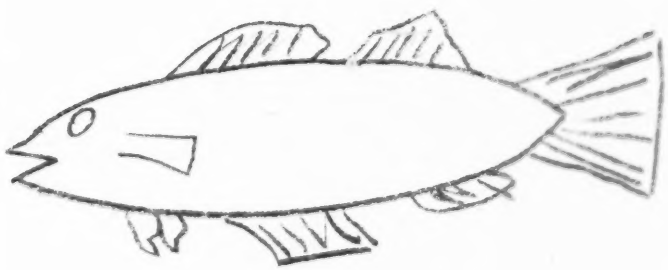


Chinook SALMON
eats insects, plankton



Habitat: in cold shallow waters
Food: eats all types of shellfish (shrimp) and small fish (Salmon and Blackfish)

ATLANTIC COD WALRUS; Molluscs, small seals

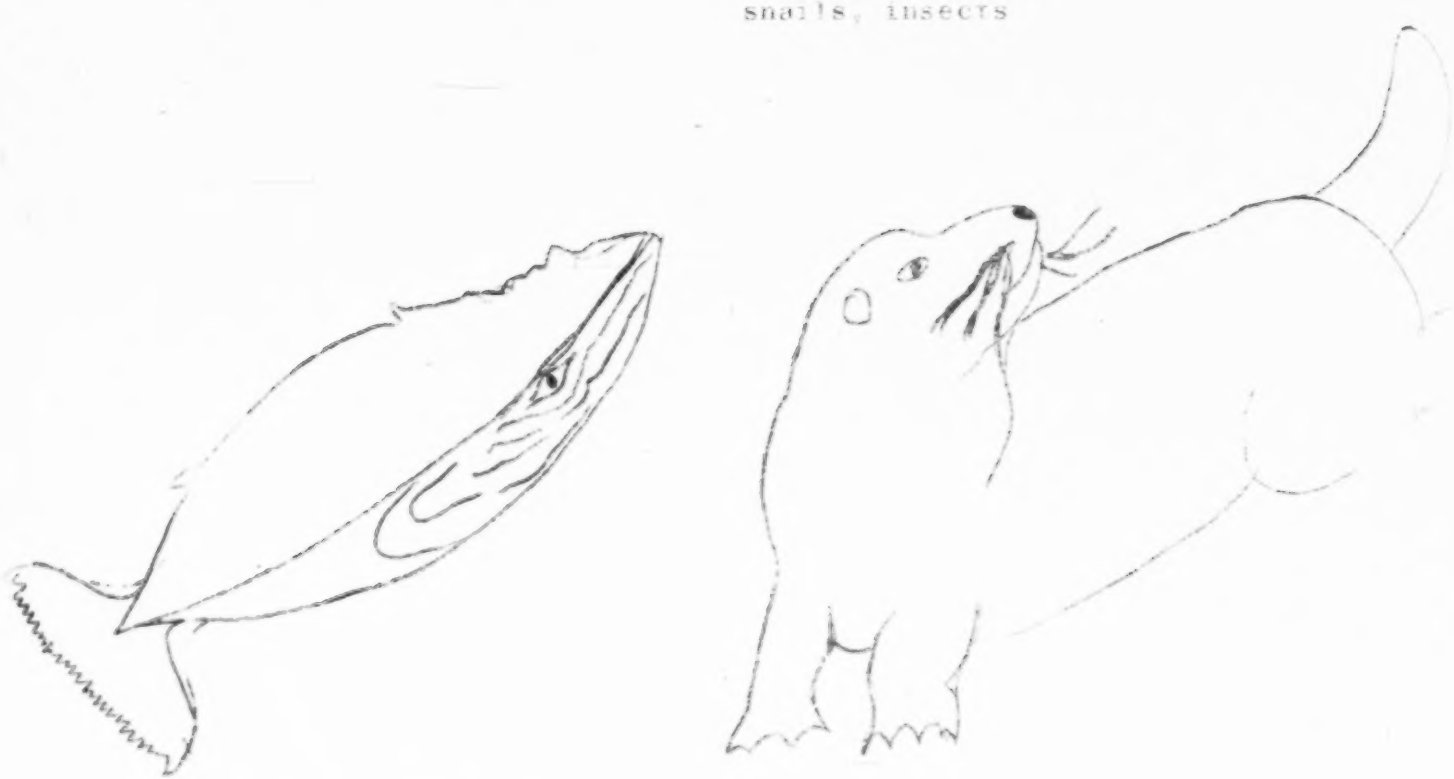


Squid, fish, crustaceans

WHALE

Carnivore
Food: crayfish, fish, amphibians, snails, insects

RIVER OTTER

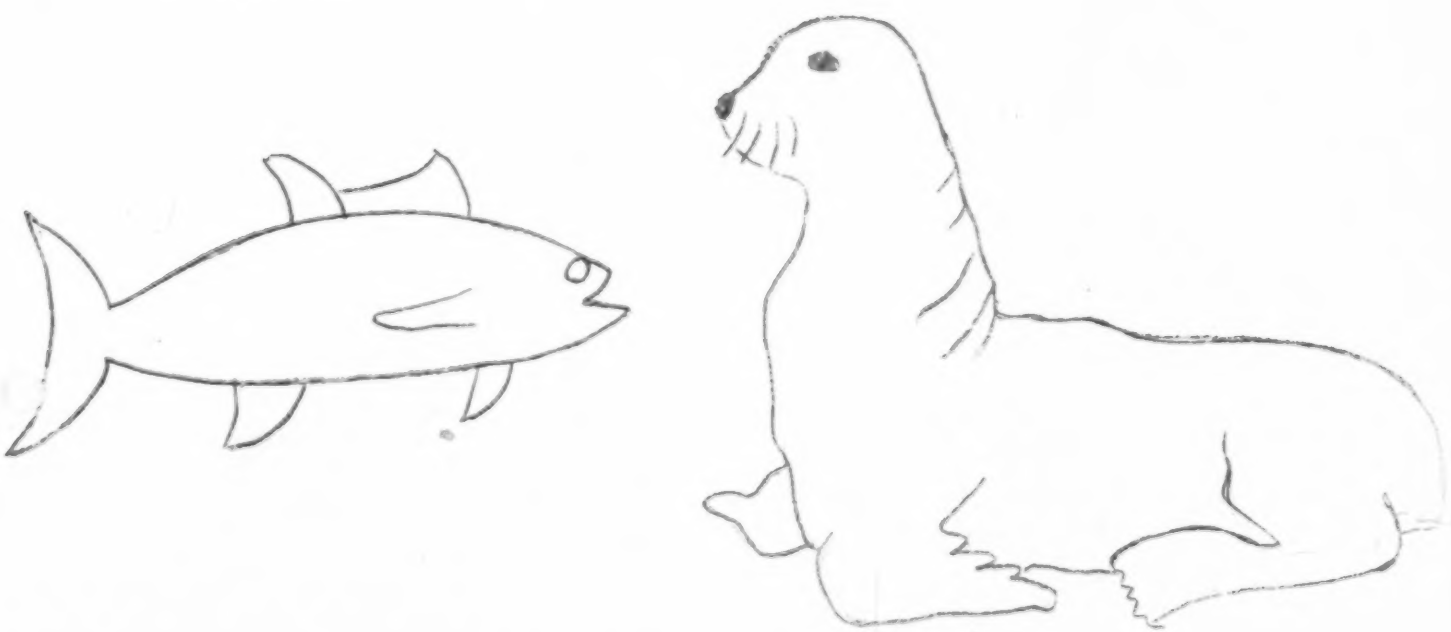


Habitat: found throughout arctic waters.
Food: eats all live small animals- Salmon, Blackfish, Shrimp, Cod

YELLOWFIN TUNA

Squids, fish and rocks swallowed whole

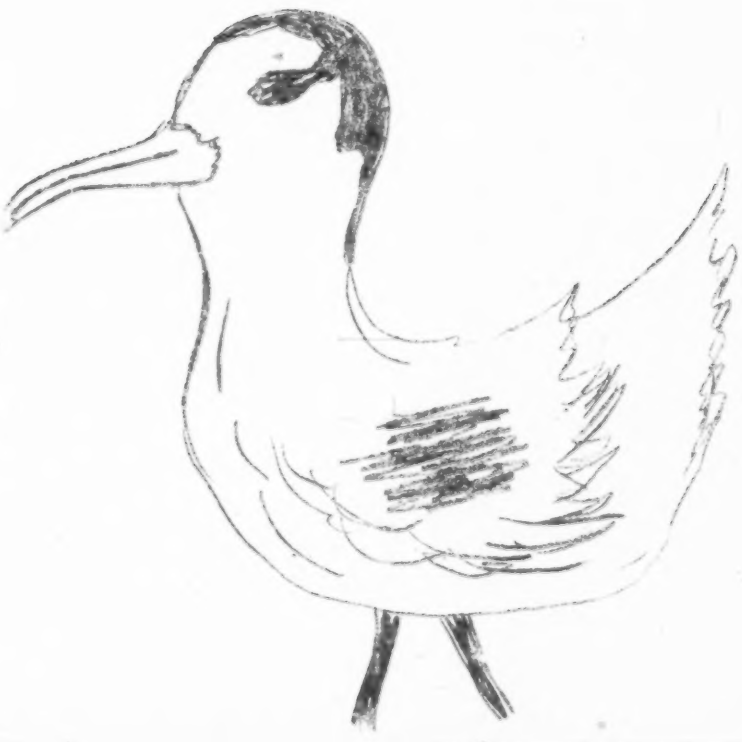
SEAL



Food: fish and anything else that comes along — SMOOTH HAMMERHEAD

Food: squid, fish, molluscs, crustaceans — ELEPHANT SEAL

Fish, Insects, Shellfish, Worms — ARTIC TERN



Fish — AUK

Any type of raw meat

HUSKIE Scavenger

KING CRAB

Food: any type of raw meat
(a predator)

WOLF ☆

ACTIVITY PLANS

UNIT III: NATURE'S LAW OF SUPPLY AND DEMAND

TIME: $\frac{1}{2}$ period

TO THE TEACHER:

1. Arrange desks or preferably chairs in a large circle.

2. Select two or three students to represent "chemical energy" (or "mother-nature"). These students should have a ball of yarn and scissors. Place them inside the circle.

3. The other students should form the circle, each with a niche card and two large paper clips attached to opposite ends of the card (see Supplement # 19).

4. The three in the center begin to construct the web by each handing a producer one end of the yarn. The yarn is unravelled to a herbivore and cut; the herbivore tucks the yarn under the paper clip labelled "I ATE IT". The herbivore takes one end of the ball of yarn and tucks this end under the clip labelled "FEEDS ON ME". The yarn is unravelled to a primary carnivore that feeds on the herbivore and cut. The carnivore tucks the cut end under his clip labelled "I ATE IT". This carnivore takes one end of the ball of yarn and tucks it under the clip labelled "FEEDS ON ME". The yarn is unravelled to a carnivore that feeds on the primary carnivore. This process continues until each organism is satisfied that it is connected to all the organisms it feeds on. Naturally the bacteria will be connected to all the organisms.

5. A moment can be spent in exhausted appreciation of the web thus constructed!

POST-ACTIVITY PLANS

UNIT III: NATURE'S LAW OF SUPPLY AND DEMAND

TIME: ½ period

Working within the remaining time allowance, the following situations can be enacted:

a. To visualize the loss of useable energy along the food chains, each producer can be handed a number of squares* of paper each representing a molecule of food (i.e. potential chemical energy). Since each producer would use some of his own food, he keeps a piece of paper and passes the rest along the chain to the herbivores. The herbivores must keep one molecule to use and then pass the rest along the chains. This continues, each organism (being fed) keeping one molecule and passing the rest along. When all the food molecules are gone, the organisms not fed are asked to stand up. Brief discussion should point out that (1) there is definitely a limited amount of food and (2) the useable energy is consumed and must be replenished by producers utilizing radiant energy.

b. To dramatize the far-reaching effects of pesticide poisoning, the producers can be handed a stack of DDT molecules. Keeping one, the producers pass the rest along the chain until all the organisms are contaminated--none should be spared!

c. To investigate the dependency of all organisms on the producers (this is a good one with which to end), postulate a stress that would kill the producers. Again, DDT is an excellent choice, or air pollution, (or siltation in water) that screens out solar radiation. The producers drop their yarn and the herbivores 'reel it in'. Any organism that loses all its food sources must then die, releasing the yarn it holds.

SUGGESTIONS:

A. For an advanced class, or if the food web is made more than once, various colors of yarn can be used to show either the different trophic levels, the different habitats: land, sea (deep vs shallow), air, or any type of relationship desired.

*The total number of squares should be five less than the total number of oiganisms.

B. The post-activity discussion can be extended with students suggesting stresses. An example for a marine community is: contamination and/or death of the filter feeders (like clams) who concentrate radioactive wastes (from nuclear reactors) that are leaking from a barrel dumped in the ocean. A land-based community can be stressed by hunters eliminating certain key organisms (for trophy), to eliminate species that compete with domestic animals, or to eliminate 'pests'.

UNIT III: NATURE'S LAW OF SUPPLY AND DEMAND

INTRODUCTION TO ACTIVITY

A Towering Puzzle

TIME: 4 periods

GOAL:

To prepare a three-dimensional pyramid of numbers that will show the numerical relationships among the levels of a food chain and the successive dependencies of each organism on the next.

INTRODUCTION:

The directions for construction of the pyramid must be followed exactly or the activity will not succeed. However, the effort is well worth the results since the ensuing discussion and subsequent students' comprehension is greatly enhanced by the presence of a three-dimensional, maneuverable model that the students themselves have planned and constructed.

The boxes used in making the pyramid must be measured beforehand to determine how large a square can be cut out of the top of each box so that the next smaller box "just fits" on top without falling through the hole of the box under it. Refer to sketches* below. Either write directions for the students so they will cut the hole out of their box to the proper dimensions, or draw the cut-out lines yourself.

The sides of each box must be numbered, one number assigned to each food chain. See diagram below.

MATERIALS:

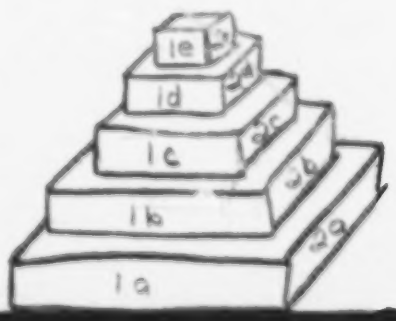
5 boxes prepared as diagrammed below

Key:

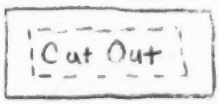
level e - top carnivore
level d - secondary carnivore
level c - primary carnivore
level b - herbivore
level a - producer

numbers 1 and 2 refer to different food chains

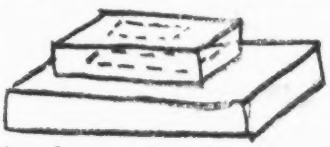
Side view:



Top view of box a



Side view of boxes a and b



Note: dotted lines delimit area to be cut out

Materials needed for pyramid:

paper to cover the sides of the boxes (paper can be replaced by each class)

crayons, felt markers, or colored chalk

staples, thumb tacks, tape or glue

knives, razor blades, or scissors

reference books for food chains

directions for making the pyramid: Supplement # 21

examples of food chains: Teacher Supplement # 22

optional: Supplements # 23 and # 24
Test, Supplement # 25; answer sheet Supplement # 26

TEACHER SUPPLEMENT # 21

Directions For Making The Pyramid

Provide each group with one (or more) set of directions to construct their part of the pyramid. The directions will read the same except for the statements underlined. Substitute the proper words as indicated for the various boxes.*

STUDENTS' DIRECTIONS FOR BOX a(or b, c, d, e)

Step 1. Obtain four sheets of paper and cut each to fit a side of the box. Do not attach the paper to the box yet.

Step 2. Students who made the same food chain work on the same sheet of paper.

Step 3. Find the side of the box that has the number of your food chain. Use the paper cut to fit this side.

Step 4. QUICKLY draw 100 organisms of the type of your food chain that fits the niche of producer. (Note substitutions for b, c, d, e.)

Step 5. Attach this drawing to the box ON THE CORRECT SIDE.

Step 6. In large print write the number "40,000,000 across the drawing. (Note substitutions for b, c, d, e.)

Step 7. Cut a hole in the top of the box by cutting along the RED LINE.

Step 8. Help others if you have time.

*Substitutions

BOX (trophic level)	STEP	REPLACEMENT
b	4	50, herbivore
	6	8,000,000
c	4	25, primary carnivore
	6	4,000,000
d	4	10, secondary carnivore
	6	40
e	4	1, top carnivore
	6	1

NOTE TO THE TEACHER: The large numbers that are written across the drawings are a more realistic estimate of the numbers of organisms at each level that can support the numbers of organisms at the next level. Most biology texts have an adequate description of ecological pyramids.

PRE-ACTIVITY PLANS

A Towering Puzzle

UNIT III: NATURE'S LAW OF SUPPLY AND DEMAND

TIME: 2 periods

TO THE TEACHER:

This can be omitted if you prepare the food chains yourself.

The class is divided into four groups, each group assigned or selecting an entirely different type of community (e.g. marine, freshwater, desert, forest, open field, human subdivision, swamp or marsh, savannah, tundra, decaying log).

The assignment is to write a five-link food chain characteristic of the community selected. A sketch of each organism should be included. Refer to Supplement # 22 for examples. The students may be asked to sketch a scene representative of the community being studied. A written and/or orally presented synopsis of biotic and abiotic factors and how they interact may be required. Each student in the group should have a copy of the food chain, including all items as they are presented in Supplement # 22. Other examples can be found in Supplement # 14.

ACTIVITY PLANS

A Towering Puzzle

UNIT III: NATURE S LAW OF SUPPLY AND DEMAND

TIME: 1½ periods

TO THE TEACHER:

Don't explain to the students that they are making a pyramid since this will deprive them of part of the reasoning they should perform themselves.

Divide the students into five groups (one group per box), including at least one student in each group representing each

of the four food chains studied. Each student will need the copy of the food chain his "pre-activity group" prepared. Number the four food chains (one to four). Tell the students to remember the number applied to their own food chain.

Hand each group a box and the directions (Supplement # 21) for making that level of the pyramid. Curiosity and puzzlement should be fostered and stimulated, but encourage the students to "figure it out" themselves. Stress the importance of following the instructions exactly, particularly attaching their paper to the correct side of the box, matching the number assigned to their food chain with the same number on the side of the box.

After the students have completed the drawings, everyone should sit in a large circle or square facing each other.

Ask for volunteers to enter the circle with a box and fit all the boxes together so they tell a story (or illustrate as many ecological concepts as possible). Encourage all students to offer suggestions.

After the students have correctly constructed the pyramid, with the four food chains properly aligned, ask everyone to sit down.

Turn the boxes so all the students can look at each of the sides. Ask them to imagine that they know nothing about ecology (!) and to use the pyramid to explain as much about ecology as they believe the pyramid displays.

TEACHER SUPPLEMENT # 22

Examples Of Food Chains

COMMUNITY: Desert

Producer --- Herbivore --- Primary Carnivore --- Secondary Carnivore --- Top Carnivore

Joshua Tree

Traderats

Rattlesnake

Road Runner

Coyote

COMMUNITY: Pond

Producer --- Herbivore --- Primary Carnivore --- Secondary Carnivore --- Top Carnivore

Algae

Tadpole

Fish

Duck

Man

COMMUNITY: Forest

Producer --- Herbivore --- Primary Carnivore --- Secondary Carnivore --- Top Carnivore

Tree

Termite

Bird

Weasel

Hawk

POST-ACTIVITY PLANS

A Towering Puzzle

UNIT III: NATURE'S LAW OF SUPPLY AND DEMAND

TIME: ½ period

TO THE TEACHER:

The following questions can be posed to analyze in depth the significance of the pyramid.

1. a. How many molecules ("pieces") of DDT would end up in in the top carnivore if each producer is sprayed and takes up only one molecule of DDT?

   b. What special warning does this present to man?

2. a. If the human population keeps on growing, what will people be eating in the future? That is, what will the pyramid look like?

   b. Why?

NOTE: The students should realize that we will be eating the producers directly because of the waste of chemical energy (mass of flesh, bones, etc. uneaten and lost as heat) inherent in a five-link food chain.

3. Why does it take so many producers to support the consumers?

4. Why do the boxes decrease in size?

5. a. If I pull out one box (do this) why does the pyramid collapse.

NOTE: It <u>should</u> if the holes were cut the right size!

   b. Which is the only box you can remove from the pyramid without causing it to collapse?

NOTE: The <u>top</u> one, which is why it would be a good idea to have a food chain with man as top consumer.

   c. What message does this present to man, who generally feels that all life on earth exists 'FOR MAN'?!

6. In what way(s) do(es) the pyramid not portray the complete story of interdependencies?

NOTE. it doesn't show the needs of the producers, the decomposers are omitted, often the top carnivore is capable of feeding directly on the producer or herbivore, the numbers may be inappropriate because in some cases a whole organism is eaten while in other cases only a fraction is consumed (like the leaves on a tree)

STENCIL

SUPPLEMENT # 25

STATEMENT: COWS FEED ON GRAIN. THE GRAIN IS FULL OF ENERGY! BUT ONLY 10% OF THIS ENERGY GETS INTO THE BEEF FOR US TO EAT.

QUESTION: How MUCH ENERGY HAS BEEN "LOST"? (Actually it's been used) SOMEWHERE BETWEEN THE GRAIN AND THE COW?

ANSWER: _____

WHY DOESN'T THE COW GET ALL THE ENERGY CONTAINED IN THE PLANT?

_____

_____

_____

STATEMENT: AS THE HUMAN POPULATION GROWS AND GROWS, MORE AND MORE FOOD WILL BE NEEDED.

QUESTION: WHAT DO YOU PREDICT FUTURE GENERATIONS OF MAN WILL BE EATING: GRAIN , OR BEEF?

ANSWER: _____

EXPLAIN WHY:

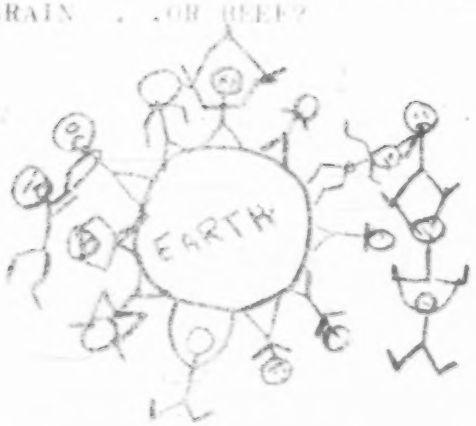
_____

_____

_____

_____

_____



SUPPLEMENT # 24

Answers To Supplement # 23

I. 90%
The plant uses some of the energy to grow, to repair, to respire, to produce its own food. Also, the cow doesn't absorb the entire plant.

II. Grain
There is too much waste of space and food needed to support intermediate organisms in a food chain.

NOTE: An interesting side line would be to pursue the prospect of a two-link food chain all over the world; Man and his producer organism. Would it be a balanced ecosystem? Would man be able to survive <u>psychologically</u> in such an environment.

STENCIL

SUPPLEMENT # 25

Test On

Nature's Law of Supply And Demand

INSTRUCTIONS: Please use your own paper. Be as brief as you can but answer all questions completely.

1. Write the names or draw the organisms that would make up a five-link food chain. Please try not to include a scavenger or parasite since they represent a sidelight to food chains.

2. Under each of the organisms you wrote or drew above write the correct term (from the following): top carnivore, primary carnivore, producer, decomposer, secondary carnivore, herbivore.

3. What is the original (first) source of ENERGY for any food chain?

4. What is the difference between a food chain and a food web?

5. Wildlife officials noted the deer population of Aurora, N. C. was steadily declining. Thus, officials ordered no hunting in certain areas for seven years. After four years the deer population had increased greatly but at the end of six and a half years the deer population of Aurora was all but gone.

   Given this information what relationships might have caused the decline of the deer population?

6. A duck haven was located in eastern N. C. by local wildlife officials. Hunters flocked to the area. Officials allowed a limit of two ducks per hunter. For most hunters to achieve this limit, it would take an average of three shots to kill one duck. This 'open season' on ducks in the area continued for several years. Wildlife officials began to record large fish kills in this duck haven as a result of lead poisoning.

   Officials were puzzled as to the cause of the lead poisoning because they knew no industry had put lead waste into the surrounding waters. What do you think was the source of the lead poisoning?

   What other organisms will you expect to be in danger of lead poisoning now? Why?

Supplement # 25 (Cont.)

7. Rabbits' first choice of food is grass, and
   a. their second choice of food is soybeans.
   b. Grasshoppers eat grass.
   c. Hawks eat rabbits.
   d. Bluejays eat grasshoppers.
   e. Bacteria feed off decaying materials.
   f. Decaying materials return nutrients to the soil.

   First, what would happen to <u>each</u> of the <u>organisms</u> in the cycle if <u>only</u> the rabbits were eliminated?

   Second, what would happen to <u>each</u> of the <u>organisms</u> in the cycle if <u>only</u> the grasshoppers were eliminated?

8. In an ecosystem where only the plants took in radioactive minerals (resulting from nuclear testing), and the following food chain was present, which of the organisms would end up with the most radioactive minerals within 10 years?

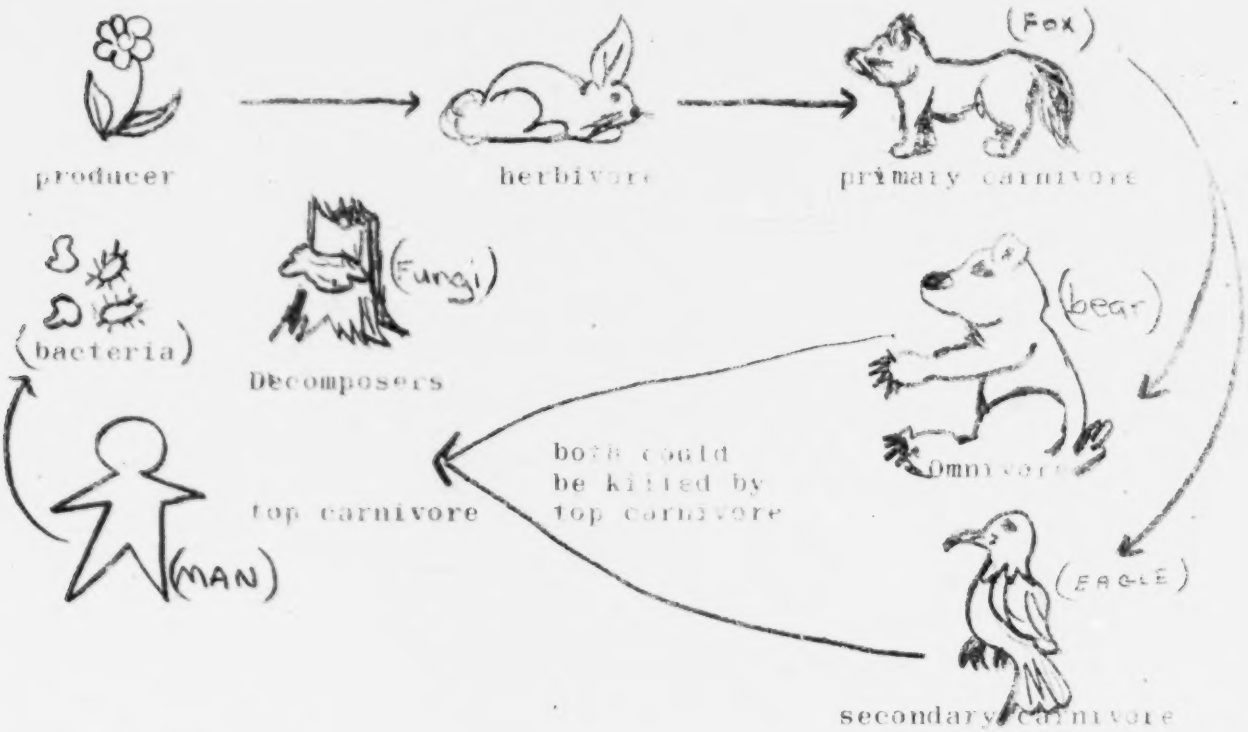
   wheat------- cows-------- man

   Explain why you selected the organism.

TEACHER SUPPLEMENT # 26

Answers To Supplement # 25

NOTE: Since answers may vary, the following is a reproduction of the answers given by one of our students.



3. Sunlight for plants

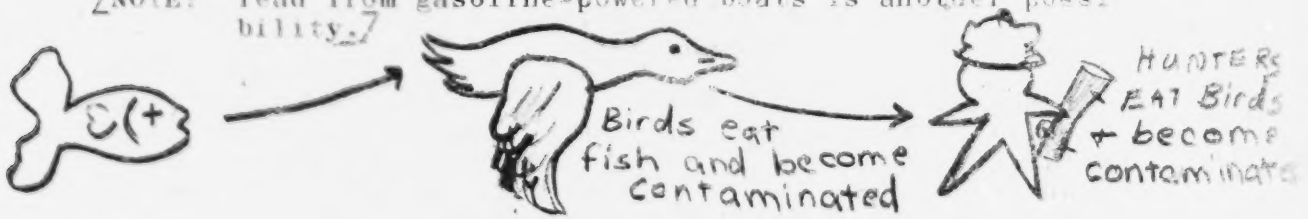
4. A food chain is a list of organisms that depend on each other for food. Starting with producers up to top carnivore.

   A food web is all interconnecting food chains in a community

5. In my opinion the deer population died out because of mass starvation. For all the new fawns there had to be food, but the competition for food among the large deer population prevented it, therefore causing the death of the reproducers. (fawns)

6. I think the lead poisoning was caused by the hunter's ammunition, (which contains lead pellets). Now that the fish have gotten lead poisoning something like this might happen.

   NOTE: lead from gasoline-powered boats is another possibility.



Supplement # 26 (Cont.)

Birds eat fish and become contaminated.

Hunters eat birds and become contaminated.

7. (a) rabbits die out — grass and soybeans become more plentiful — grasshoppers multiply greatly

blue-jays multiply greatly

since blue-jays eat other birds' eggs then other species of birds may become scarce

(b) grasshoppers die-out

Grass becomes more abundant

Blue-jays have nothing to eat so they die out

Rabbits have more to eat, and become even more abundant

Hawks have more to eat, so they reproduce more

hawks eventually eat all rabbits which causes them to die out

Rabbits eventually eat all the grasses and soybeans, which causes mass starvation. Also the hawks take a large fall.

Bacteria feed off the decaying materials.

Decayed material fertilizes soil for producers to start growing again.

8. I believe man would end up with the most because the wheat would contain a small amount, which the cow would eat in large quantities and a man who eats the cows receives an even larger amount of radioactiveness, which, within 10 years would reach a dangerously high amount.

UNIT IV PLAN

UNIT IV TITLE: TO EACH HIS OWN

TIME: 14 periods

PURPOSE OR OBJECTIVE:

To investigate the interrelationships of organisms and their physical environment. Specifically, for students to understand the following concepts.

1. Populations are limited by biological and physical factors, thus maintaining a balance in nature.
2. Organisms continuously alter their own environment, making it less inhabitable for themselves, but perhaps more inhabitable for other species.
3. Each species has structural and physiological characteristics enabling it to function successfully in its habitat and niche.
4. Organisms that cannot adapt to change, die.
5. Change as the result of environmental stress, may not be immediately evident, sometimes requiring months or years to be effected.

ABSTRACT:

The major activity is a transect study in which the students collect physical and biological information about various environments and analyze this data in an attempt to discover the relationships that exist among the organisms and the physical factors in specific communities.

The other two activities stress adaptation. "The Adaptation Angle" challenges students to design environments and then to construct organisms that can adapt to these environments or vice versa. "The Adaptable Treasure Hunt" involves the students in preparing a list of organisms that display a particular adaptation. . .and then to find these.

UNIT IV SCHEDULE

A Transect Study - The Ecologists' Thing	Pre-Activity	4 periods
	Activity	half-day
	Post-Activity	4 periods
The Adaptation Angle	Pre-Activity	1½ periods
	Activity	1½ periods
An Adaptable Treasure Hunt		2 periods

UNIT IV: TO EACH HIS OWN

INTRODUCTION TO ACTIVITY

A Transect Study - The Ecologists' Thing

TIME: 9 periods

GOAL:

To plan and implement, then organize and evaluate the data from a transect study.

INTRODUCTION:

The students obtain first hand knowledge of the use of field equipment in an ecological study. They learn how to measure temperature, wind velocity, light intensity, relative humidity; how to collect soil organisms using a fullgren funnel apparatus; how to do a plant population study along a transect; and how to make a soil analysis. In addition, they learn how to organize data so it can be analyzed and evaluated.

It is important the students realize that the knowledge and understanding of the relationships observed during the study are limited by the amount of, and accuracy of, measured data that is collected. Most equipment can be made by the students; however, if any equipment is unobtainable, the corresponding activity can be omitted. Activities can be omitted or modified commensurate with students' abilities.

MATERIALS NEEDED FOR TRANSECT STUDY

PER GROUP (many items can be shared across groups)

pre-activities:
1 coathanger
Supplement # 26, Flight Types
1 wind gauge, Supplement # 30
1 thermometer
cheesecloth

pre-activities:
Supplement # 28, Relative Humidity Chart
Supplement # 27
graduated soil sieves
balance
Supplement # 29, Soil Analysis

activity:
thermometer, 1 cotton ball
12" ruler
wind gauge, Supplement #30
Buchner funnel apparatus, Supplement #30
1 spoon or trowel
alcohol
clothesline or rope, 10' per group
tape or stapler
plastic wrap or bags
2 no. 303 size cans
1 fruit juice can, one quart, open at both ends
1 glass jar, one quart
data sheets, Supplement # 31
Relative Humidity Chart, Supplement # 28
graduated soil sieves
1 coathanger
insect collecting net, Supplement # 30
balance
hand lens and compound microscope
apparatus for nematode study, Supplement # 32
Teacher Supplement (for preparing graphs) # 31
large sheets of paper for preparing charts

post activity:
Supplement # 33, Analyzing the Data

SUPPLEMENTS

26. Pre-Activity: Plant Types

27. Pre-Activity: Temperature, Relative Humidity, Wind Velocity

28. Relative Humidity Charts

29. Pre-Activity: Soil Analysis

30. Instruments and Apparatus for Transect Study

31. Preparing Graphs for Analyzing Data

32. Data Sheets for Transect Study

33. Analyzing The Data

PRE-ACTIVITY PLANS

A Transect Study

UNIT IV: TO EACH HIS OWN

TIME: 4 periods

TO THE TEACHER:

The following sequence is recommended for familiarizing the students with the more complicated techniques that will be performed during the field study. You will undoubtably modify the following ideas depending upon the students' abilities and the available equipment.

Introduce the transect study: a rope will be extended along the ground, passing through a variety of environments (Ex: creek edge, swamp, open field, woods). There will be a team of three students responsible for each 10 feet along the transect, collecting as much information about their station as the class agrees on. If everyone collects the same data in the same manner, all the data can be organized and then analyzed. The relationships and variations are complex and fascinating. The study is extremely sophisticated research and requires total cooperation among all teams.

SUGGESTIONS:

1. A 100-foot transect is a convenient size. Depending upon class size and schedules, one, one and a half, or two classes could conduct one transect study.

2. One class period is used for collecting the data in the "coathanger count", (Supplement # 6), and the plants can be pressed overnight. The next day the following type of chart is made and the students asked to draw their own conclusions. . .Ex: What plant was present in the most areas; why? Ask students to propose hypotheses explaining the reason they obtained their data. They should eventually realize the necessity for collecting more data from the area: soil type, soil moisture, protection from wind, comparative temperatures, and relative humdity at the <u>same time</u>, types and numbers of animals in their respective

areas, and so forth. This should lead to an appreciation of why the transect study should be undertaken, and the necessity for all teams using exactly the same techniques.

CHART:

Plant / Group No.	1	2	3	4	5
(TAPE SAMPLE)	25	0	1	3	4
	0	30	5	8	0
	1	0	2	1	0

3. Practice measuring the physical factors. The students can be encouraged to develop their own instruments. Supplements # 27, # 28, # 29, and # 30 may be helpful. Only practice those techniques that may require practice to assure reliable and consistent data-collection. Too much practice becomes dull.

SUGGESTIONS:

Two or three students can be responsible for teaching such techniques as reading thermometers, computing relative humidity, using the wind gauge. Meanwhile, individuals or groups can be doing any or all of the following:

marking the rope in 10-foot sections, building the Tullgren apparatus
assigning teams and checking their equipment (assuming each team is responsible for bringing from home all they can)
making the wind gauge
making the necessary charts (Supplement # 31)

4. Plan with class an appropriate schedule for the field study. It is possible to collect the field data in half a day or less depending upon traveling time and student cooperation. If arrangements can be made, it might be advisable to take two classes each morning (field work requires two hours) and spend another hour completing any lab work and posting the data. Alternatively, two classes could do the field work in the morning and two in the afternoon. Completion of lab work and posting of data can be restricted to individual class periods on subsequent days. The former plan eliminates the dual problem of storage and loss of collected samples, while the latter is more convenient for most school facilities (room space) and allows time for plant samples to be dried and pressed before they are used.

STENCIL

SUPPLEMENT # 20

Pre-Activity: Plant Types

DIRECTIONS: Name _____

Select a study area. Gently toss a coathanger down in the area; and then take a sample of EACH DIFFERENT KIND of plant that is found inside the hanger area. Sketch below what each type of plant looks like (as a means of identifying it), count the number of each separate kind and write the number beside the sketch of the plant. Collect one example of each kind, place in a plastic bag, and bring back. As soon as you can get back to the room, press these plants between the pages of a book.

I. Describe area: _____

II.

Sketch of plant	Number in the area
1.	
2.	
3.	
4.	
5.	
(use back if necessary)	
6.	

COMPARISON OF CLASS RESULTS:

Were your plant types and numbers similar or different from the other students? _____

Explain why: _____

STENCIL

SUPPLEMENT # 27

Pre-Activity

TEMPERATURE: NAME_____

1. Place the thermometer flat on the ground with bulb up and record the temperature when the fluid stops moving.

_____°F (surface)

2. Make a slit in the soil by forcing in a trowel and prying forward. Pull the digging tool back. Slide the thermometer bulb into the slit to a depth of about 3 centimeters (1"). Slip the tool out and close the soil against the thermometer. Read the thermometer only after the fluid stops moving. Scrape away enough soil to take the readings.

_____°F (soil)

RELATIVE HUMIDITY:

1. A sling psychrometer is used to measure relative humidity. This psychrometer has two thermometers mounted on it. One of the thermometers has a "sock" tied around it. Wet this "sock" with distilled water. Then sling the psychrometer vigorously for two minutes. At the end of this period, record the dry bulb temperature as well as the wet bulb temperature. Then relative humidity can be determined from these readings using a chart.

_____°F dry bulb

_____°F wet bulb

_____% relative

Note: A simple psychrometer can be constructed for this activity - see Supplement # 30.

WIND VELOCITY:

1. Make a wind gauge as directed by the instructor.

2. Use your wind gauge to check wind velocity in a windy area and in an area with little wind. Take readings at six inches above the ground and at two feet above the ground. Then draw the angle that the wind made at each location, or take the appropriate reading depending upon the type of gauge used.

Windy 6"	Windy 2 ft.	Not Windy 6"	Not Windy 2 ft.
Describe location on back.		Describe location on back.	

Supplement # 28

Relative Humidity Charts

1. 21° - 59° F Relative Humidity From Wet and Dry Bulb Thermometer

Dry Bulb °F \ DB-WB °F (+)	.36	.72	1.1	1.5	1.8	2.2	2.5	2.9	3.2	3.6	4.0	4.3	4.7	5.0	5.4	5.8	6.1
+21.2	95	90	85	79	74	69	64	59	54	49	45	40	35	30	25	20	15
23.0	95	90	86	81	76	71	66	62	57	52	48	43	39	34	29	25	20
24.1	95	91	86	82	77	73	68	64	59	55	51	46	42	38	33	29	25
26.6	96	91	87	82	78	74	70	66	62	57	53	49	45	41	37	33	29
28.4	96	92	88	84	79	75	71	68	64	60	56	52	48	44	40	37	33
30.2	96	92	88	84	81	77	73	69	66	62	58	54	51	47	43	40	36
32.0	96	93	89	85	81	78	74	71	67	64	60	57	53	50	46	43	40
33.8	97	93	90	86	83	80	76	73	70	66	63	59	56	53	49	46	43
35.6	97	93	90	87	84	81	78	74	71	68	65	62	59	55	52	49	46
37.4	97	94	91	88	84	82	78	76	72	70	67	64	61	58	55	52	49
39.2	97	94	91	88	85	82	79	77	74	71	68	65	62	60	57	54	51
41.0	97	94	91	88	86	83	80	77	75	72	69	67	64	61	58	56	53
42.8	97	94	92	89	86	84	81	78	76	73	70	68	65	63	60	58	55
44.6	97	95	92	89	87	84	82	79	77	74	72	69	67	64	62	59	57
46.4	97	95	92	90	87	85	82	80	77	75	73	70	68	65	63	61	58
48.2	98	95	93	90	88	85	83	81	78	76	74	71	69	67	64	62	60
50.0	98	95	93	90	88	86	83	81	79	77	74	72	70	68	66	63	61
51.8	98	95	93	91	89	86	84	82	80	78	75	73	71	69	67	65	62
53.6	98	96	93	91	89	87	85	82	80	78	76	74	72	70	68	66	64
55.4	98	96	93	91	89	87	85	83	81	79	77	75	73	71	69	67	65
57.2	98	96	94	92	90	88	86	84	82	79	78	76	74	72	70	68	66
59.0	98	96	94	92	90	88	86	84	82	80	78	76	74	73	71	69	67

Supplement # 28 (Cont.)

Relative Humidity From Wet and Dry Bulb Thermometer

DB-WB °F (+) Dry Bulb °F	6.5	6.8	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1	18.0	18.9
+21.2	11	6														
23.0	16	11	7													
24.1	21	17	12													
26.6	25	21	17	8												
28.4	29	25	22	12												
30.2	33	29	26	17	8											
32.0	36	33	29	21	13	5										
33.8	40	36	30	25	17	10										
35.6	43	40	37	29	22	14	7									
37.4	46	43	40	33	26	19	12	5								
30.2	48	46	43	36	29	22	16	9								
41.0	51	48	45	39	33	26	20	13	7							
42.8	53	50	48	41	35	29	24	17	11	5						
44.6	54	52	50	44	38	32	26	21	15	10						
46.4	56	54	51	46	40	35	29	24	19	14	8					
48.2	58	55	53	48	42	37	32	27	22	17	12	7				
50.0	59	57	55	50	44	39	34	29	24	20	15	10	6			
51.8	60	58	56	51	46	41	36	32	27	22	18	13	9	5		
53.6	62	60	58	53	48	43	39	34	29	25	21	16	12	8		
55.4	63	61	59	54	50	45	41	36	32	28	24	19	15	11	7	
57.2	64	62	60	56	51	47	42	38	34	30	26	22	18	14	10	6
59.0	65	63	62	57	53	48	44	40	36	32	27	24	20	16	13	9

Supplement # 28 (Cont.)

II. 61° - 80° F

Temperature of Dry Bulb in ° F

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	
41	7	4	2																		41
42	10	8	6	4	2																42
43	14	12	10	7	5	3	2														43
44	18	16	13	11	9	7	5	3	1												44
45	22	20	17	15	12	10	8	6	5	3	1										45
46	27	24	21	18	16	14	12	10	8	6	4	3	1								46
47	31	28	25	22	20	17	15	13	11	9	7	6	4	3	1						47
48	35	32	29	26	24	21	19	16	14	12	10	9	7	5	4	3	1				48
49	40	36	33	30	27	25	22	20	18	15	13	12	10	8	7	5	4	3	1		49
50	44	41	37	34	31	29	26	23	21	19	17	15	13	11	9	8	6	5	4	3	50
51	49	45	42	38	35	32	30	25	24	22	20	18	16	14	12	11	9	8	6	5	51
52	54	50	46	43	39	36	33	31	28	25	23	21	19	17	15	13	12	10	9	7	52
53	58	54	50	47	44	40	37	34	32	29	27	24	22	20	18	16	14	13	11	10	53
54	63	59	55	51	48	45	42	39	36	33	30	28	25	23	21	19	17	16	14	12	54
55	68	64	60	56	52	49	45	42	39	36	33	31	29	26	24	22	20	18	17	15	55
56	73	69	64	60	56	53	50	47	44	41	37	34	32	29	27	25	23	21	19	18	56
57	78	74	69	65	61	58	54	51	48	45	41	38	35	33	30	28	26	24	22	20	57
58	84	79	74	70	66	62	58	55	51	48	45	42	39	36	34	31	29	27	25	23	58
59	89	84	79	74	70	66	62	59	55	51	48	45	42	39	37	34	32	30	28	26	59
60	94	89	84	79	75	71	67	63	59	56	52	49	46	43	40	38	35	33	31	29	60
61	100	95	89	84	80	75	71	67	64	60	57	53	50	47	44	42	39	36	34	32	61
62		100	95	90	85	80	76	72	68	64	60	57	53	50	47	44	42	39	37	35	62
63			100	95	90	85	80	76	72	68	64	61	57	54	51	48	45	43	40	38	63
64				100	95	90	85	81	77	72	68	65	61	58	54	51	48	46	43	41	64
65					100	95	90	85	81	77	72	69	65	61	58	55	52	49	46	44	65
66						100	95	90	86	81	77	73	69	65	62	59	56	53	50	47	66
67							100	95	90	86	81	77	73	69	66	62	59	56	53	50	67
68								100	95	90	86	82	78	74	70	66	63	60	57	54	68
69									100	95	90	86	82	78	74	70	67	63	60	57	69
70										100	95	91	86	82	78	74	71	67	64	61	70
71											100	95	91	86	82	78	74	71	68	64	71
72												100	95	91	86	82	79	75	71	68	72
73													100	95	91	87	83	79	75	72	73
74														100	96	91	87	83	79	75	74
75															100	96	91	87	83	79	75
76																100	96	91	87	83	76
77																	100	96	91	87	77
78																		100	96	91	78
79																			100	96	79
80																				100	80
	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	

Temperature of Wet Bulb in ° F

STENCIL

SUPPLEMENT # 27

Pre-Activity: Soil Analysis

Name _____

One of the easiest ways to determine soil texture is to oven dry a soil sample at 105° to 110° for 24 to 48 hours, then weigh the oven-dried sample. The soil sample is then introduced into a nest of soil sieves. Each sieve will have a different mesh diameter, with the largest mesh size situated at the top. The sieves are then agitated by hand to separate the different soil particle sizes. By weighing each sieve separately, the percentage weight of each soil size class can be determined and the type of soil present in a particular area is then known. Soil particles with a diameter larger than 2.0 mm are gravel soils; those with diameter ranging from 0.02 to 2.0 mm are sands. Soil particles with diameters of 0.002 to 0.02 mm are silts. The finest textured soil, with particle diameters of less than 0.002 mm are clays.

To find the percentage of any soil particle type, follow this formula:

$$\frac{\text{Weight of particles}}{\text{Total weight of sample}} \times 100 = \text{percent particle type}$$

DIRECTIONS: Weigh a paper towel. Place the total dried soil sample on the paper towel and weigh the sample and towel together. Subtract the weight of the towel to get the weight of the sample. Record this. Place the soil sample in the top of a nest of soil sieves and shake vigorously for a few minutes. Then weigh the contents of each sieve separately on the paper towel. Subtract the weight of the towel each time and record the weights, then determine the percent of each type of particle in the total sample.

Supplement # 29 (Cont.)

Sieve No. 1 (gravel) _____

% of the total sample _____

Sieve No. 2 (sand) _____

% of the total sample _____

Sieve No. 3 (silt) _____

% of the total sample _____

Sieve No. 4 (clay) _____

% of the total sample _____

Type of soil based on classification below.

_____

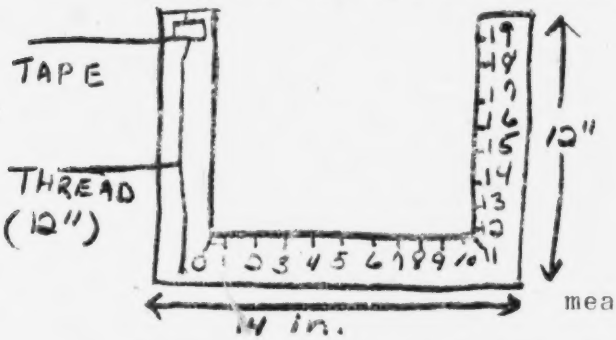
SOIL CLASSIFICATION:

Sand, less than 15% clay and/or silt
Loamy sand, 15% to 20% clay and/or silt
Sandy loam, 21% to 50% clay and/or silt
Loam or silt loam, 51% or more of clay and/or silt
Clay-loam, 20% to 30% clay
Clay, 31% or more clay

SUPPLEMENT # 30

Instruments and Apparatus for Transect Study

1. Wind gauge: Using a zigzag ruler as a model, the wind gauge is cut out of cardboard.

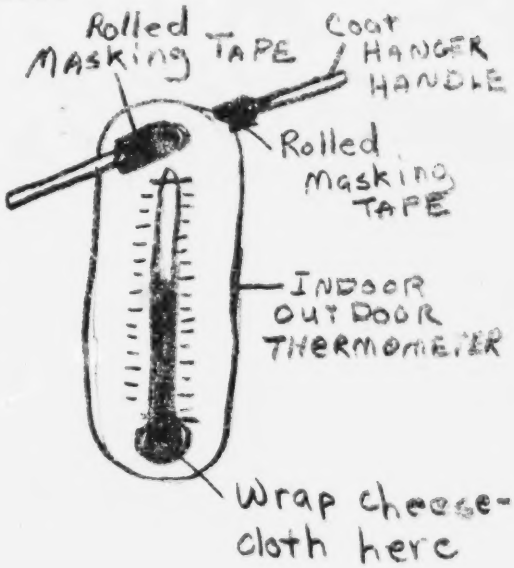


measurements are one inch apart

To use, hold wind gauge in direction wind is blowing, read the number the thread points toward.

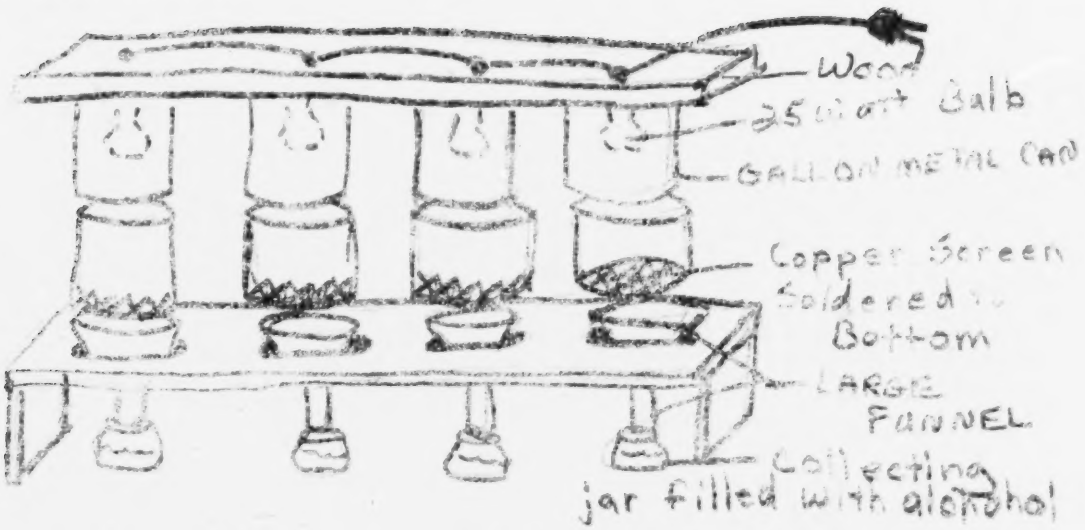
2. Sling psychrometer:

To use, swing thermometer for three minutes and read the 'dry bulb' temperature. Then wet a thin piece of cheese-cloth and wrap it securely around the bulb. Swing the thermometer three more minutes and read the 'wet bulb' temperature. Use the chart, Supplement # 28, to determine relative humidity.



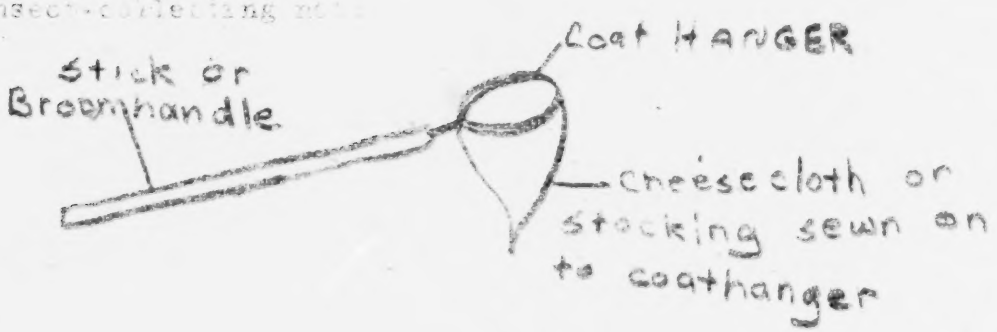
Supplement # 30 (Cont.)

3. Tullgren funnel



To use, drop soil into screen-bottomed can, leave lights on for 48 hours. During this time, small animals will retreat from the drying heat, eventually falling into the alcohol. After 48 hours, pour the alcohol into a shallow dish and examine with a hand lens or dissecting microscope.

4. Insect-collecting net



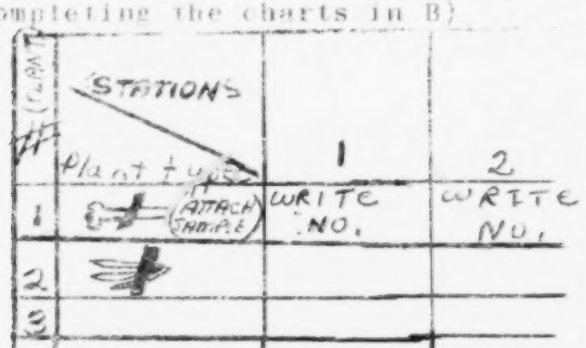
TEACHER SUPPLEMENT # 31

Preparing Graphs for Analyzing Data

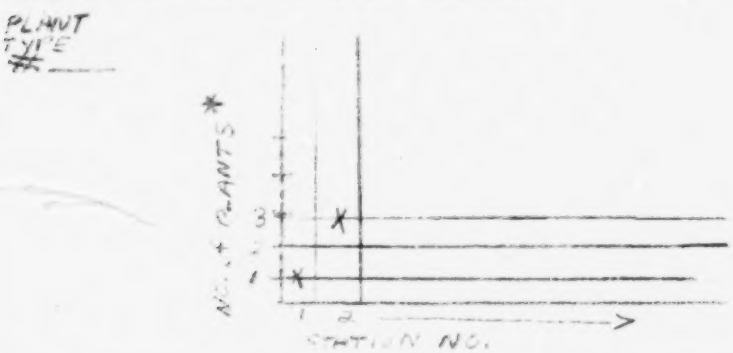
The following graphs are suggested. Students or teacher can prepare these graphs before the field study and post them on the wall.

1. Plant data

A. First post all plant data on the following chart (to determine the numbers of each type plant for completing the charts in B)



B. Prepare one chart for each plant. The teacher can visit the field study site and estimate the number of charts that will be needed.



*Omit numbers when preparing charts. After data is completed on Chart A, numbers can be written to accomodate the maximum number.

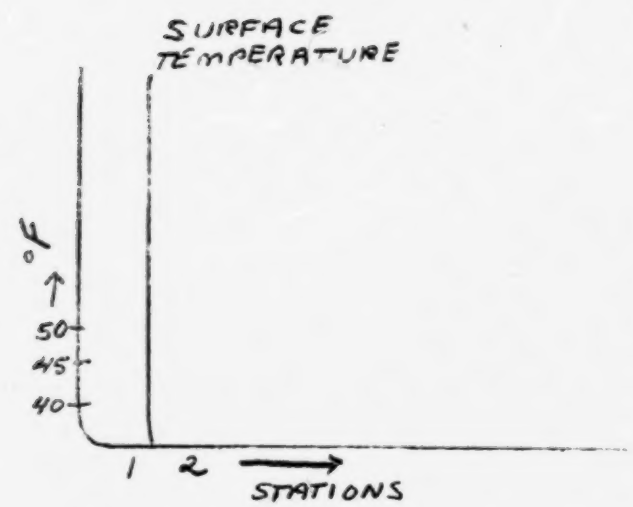
Supplement # 31 (Cont.)

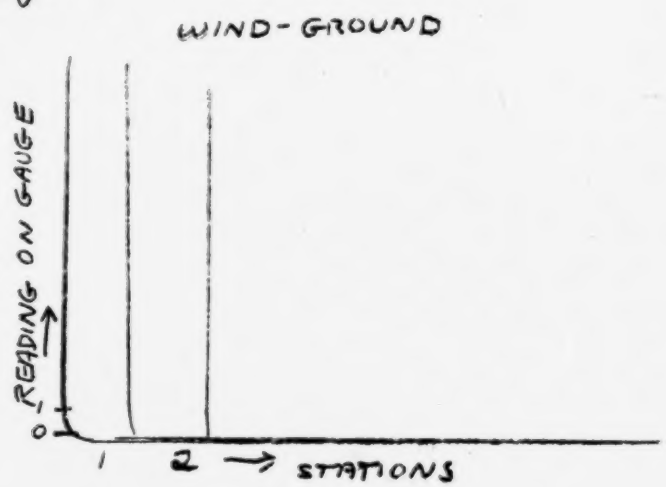
C. Height of Plants: prepare charts plotting stations vs plants below knee, plants between knee and head, plants above head

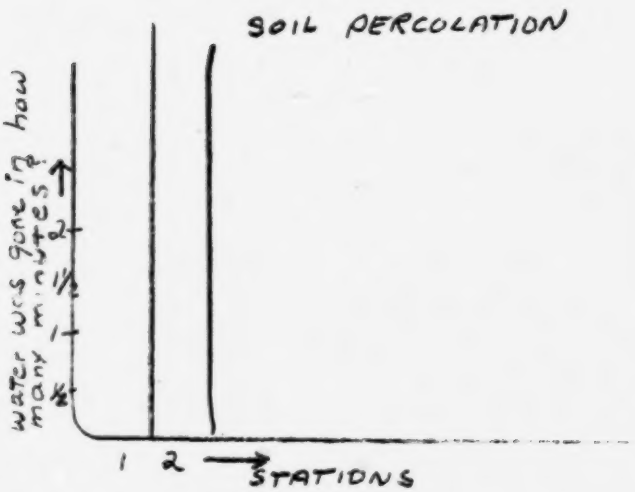
2. Animal data - plot numbers of animals vs station in the same manner as plants.

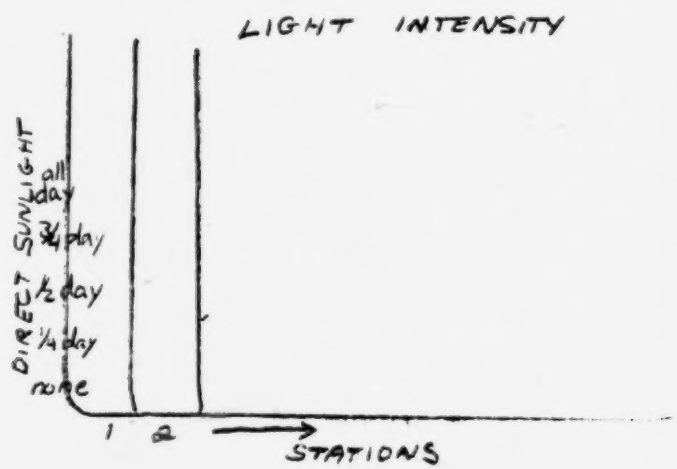
3. Physical factors - plot each physical measurement vs stations

E.g.



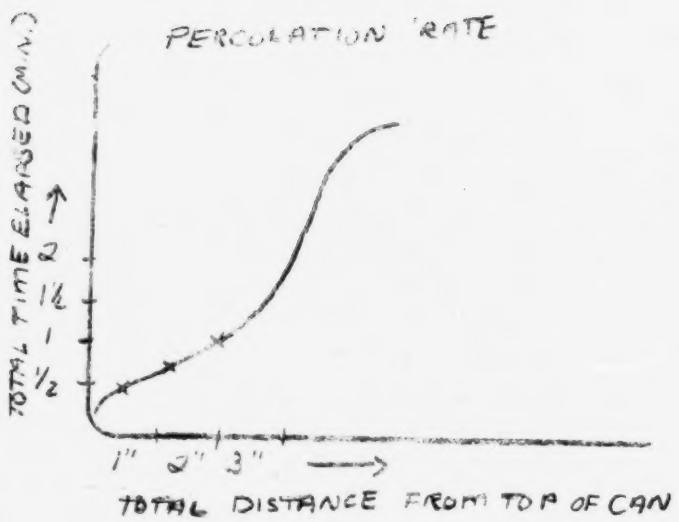


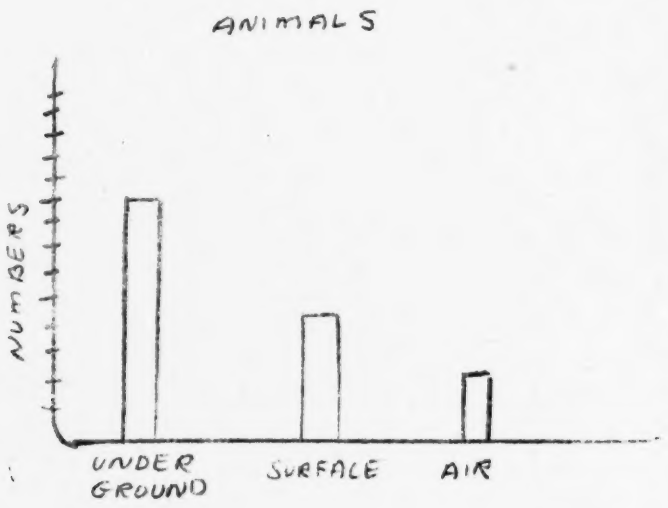




Supplement # 31 (Cont.)

4. Individual graphs - stations can graph results similar to this below.

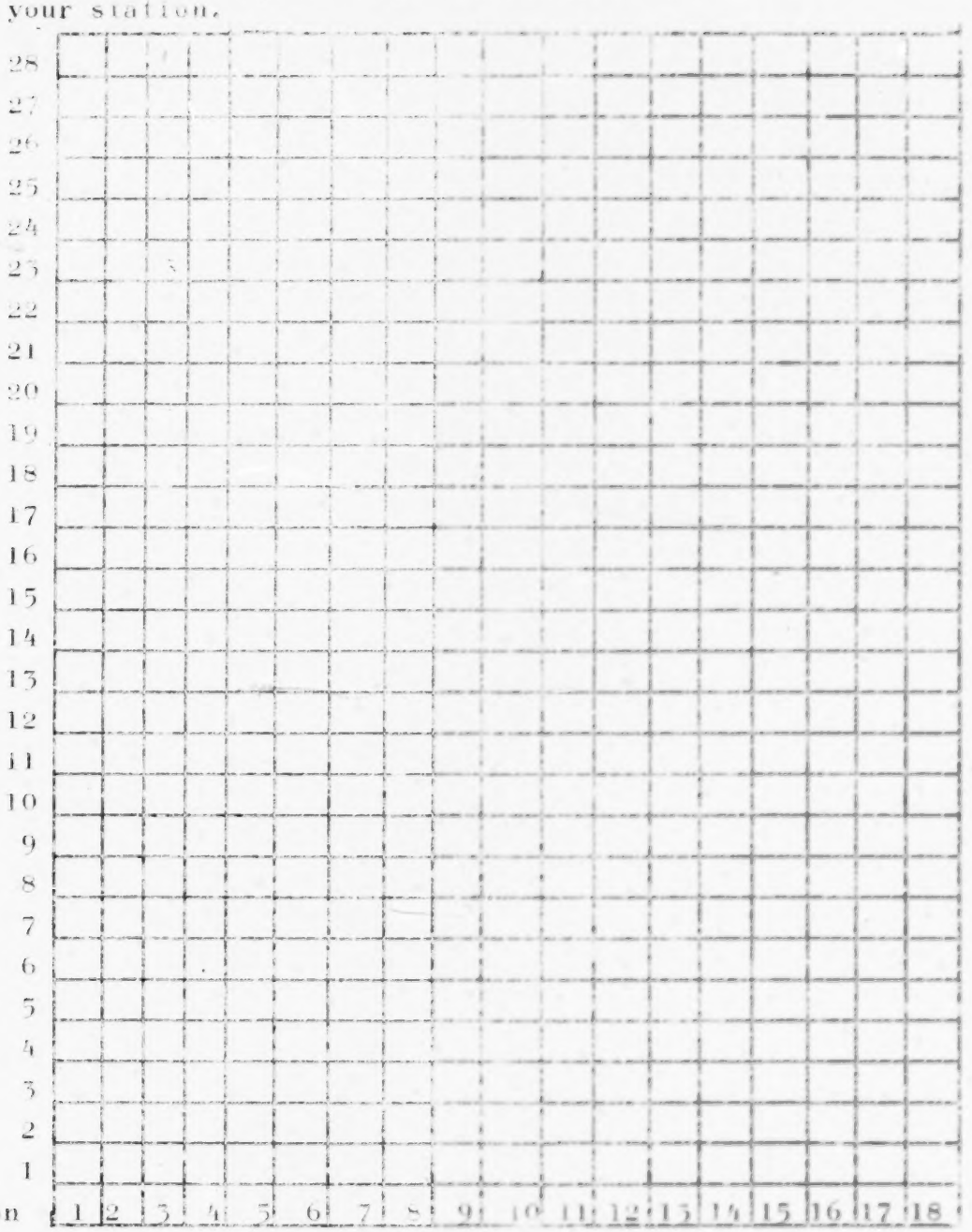




Supplement # 51 (Cont.)

This is an example of a chart that could be used for plants, insects, etc.

CHART: NUMBERS OF PLANT TYPE (Tape example of insect here)
DIRECTIONS: Find your station column and place an "X" in the square telling the number of this plant type you counted in your station.



ACTIVITY PLANS

A Transect Study - The Ecologists' Thing

UNIT IV: TO EACH HIS OWN

TIME: 3 working hours (plus travel time)

TO THE TEACHER:

The activity can be divided into two sections: field and lab.

1. Field: Students can lay the transect rope across the study area and select their stations. Number the stations consecutively, students recording their station number on each data sheet. [It would reduce classroom confusion if each transect (that is, each class) had a different set of numbers.] Refer to Supplement # 32.

2. Lab: The following must be completed.
   a. Determine relative humidity.
   b. Complete lab activities for "soil animals" and "soil analysis".
   c. Post data on chart no. 1 A (Supplement # 31).
   d. Post data on all remaining charts (Supplement # 31).

STENCIL

SUPPLEMENT # 32

Transect Station #_____ Names_____

DATA SHEET # 1

WIND VELOCITY

Directions: Write the number on the wind gauge that the thread points to; take 3 readings and average them.

a. On the ground Average _____
(divide total by 3)

reading 1._____

2._____

3._____

total _____

b. At waist level Average _____
(divide total by 3)

reading 1._____

2._____

3._____

total _____

c. Above your head Average _____
(divide total by 3)

reading 1._____

2._____

3._____

total _____

Supplement # 32 (Cont.)

Transect Station #_____ Names_____

DATA SHEET # 2

TEMPERATURE Time_____

Directions:

a. surface temperature_____ °F
Lay thermometer with scale facing up. Wait 3 minutes.

b. ground temperature (1" down)_____ °F
Make slit in soil, slide in thermometer. Shove soil back around thermometer, wait 3 minutes, scrape away enough soil to read.

c sub-soil temperature (8" down)_____ °F
repeat as described under 'b'

HUMIDITY

a. dry bulb -swing 2 minutes and read
_____ °F

b. wet bulb - wrap cheesecloth around bulb, swing 2 minutes, and read
_____ °F

c. relative humidity (from chart)
_____ %

Supplement # 32 (Cont.)

Transect Station #_____ Names_____

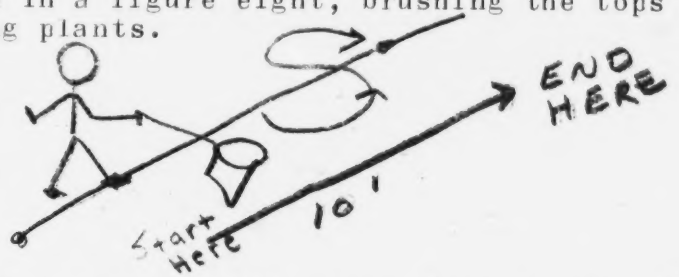
DATA SHEET # 3

ANIMALS IN THE AIR

Directions:

In the field-----

a. Using the insect collecting net, walk along your 10-foot section of rope, swinging the net <u>in front</u> of you in a figure eight, brushing the tops of low-growing plants.



b. When you stop, quickly grasp the net near the rim, preventing the insects from escaping.

c. Carefully hold a plastic bag over the rim and release the insects into the bag. Tie the bag securely closed.

In the lab-----

a. Pour a small amount of alcohol into the plastic bag. Close the bag securely.

b. Shake the bag for a minute.

c. Empty the insects onto a paper towel.

d. Record the kinds and numbers of insects.

	TYPE (sketch or name)	NUMBER
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____

Supplement # 32 (Cont.)

Transect Station #_____ Names_____

DATA SHEET # 4

ANIMALS ON THE GROUND

Directions:

a. Working your way along your section of the rope, search under the leaf litter for insects.

b. Record below the types and numbers of each type you find.

	TYPE (sketch or name)	NUMBER
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____

Supplement # 32 (Cont.)

Transect Station #_____ Names_____

DATA SHEET # 5

PLANT TYPES - short

Directions: Take one sample of each type plant lower than your knee growing against both sides of the rope. Wrap each in plastic wrap and tape or staple to this page. Count only the no. of stems coming out of the ground. Count all dead leaves together.

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

Supplement # 32 (Cont.)

Transect Station #_____ Names_____

DATA SHEET # 6

PLANT TYPES - medium

Directions: Pick a twig or leaf from each type of plant which is taller than your knees, but shorter than you are. These must be touching or hanging over your transect section.

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

Supplement # 32 (Cont.)

Transect Station #_____ Names_____

DATA SHEET # 7

PLANT TYPES - tall

Directions: Take a twig or leaf and bark sample from each type of plant which is taller than you are. These must be touching or hanging over your transect section.

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

(Attach bag here) Total number of Plants_____

Supplement # 32 (Cont.)

Transect Section #_____ Names_____

DATA SHEET # 8

SOIL MOISTURE

Directions: Pick up a handful of soil and classify the amount of soil moisture in it by the following descriptions:

a. Dry -falls apart and sifts between fingers

b. Slightly moist - appears moist but does not stick together when squeezed.

c. Moist - sticks in a clump when squeezed

d. Very moist - squeeze and the water is obvious

e. Wet - water drips.

Soil Moisture (1" down)_____

Soil Moisture (8" down)_____
(Halfway to your elbow)

LIGHT INTENSITY

Directions: Write in either: a. total exposure; b. partial exposure; c. total shade

Morning_____

Noon_____

Afternoon_____

NOTE: Look to east to judge morning exposure.
Look to west to judge afternoon exposure.
Look directly overhead to judge noon exposure.

Supplement # 32 (Cont.)

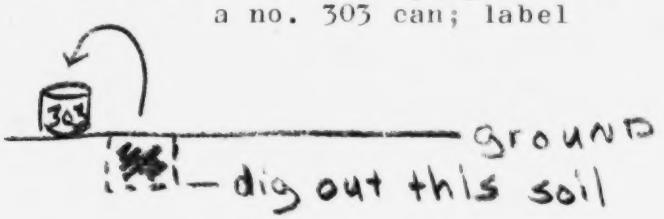
Transect Station #_____ Names_____

DATA SHEET # 9

SOIL ANIMALS

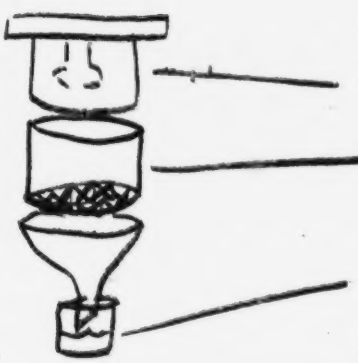
Directions:

1. In the field - collect a 'plug' of soil that fits into a no. 303 can; label



Perform either a or b:

2. a. In the lab - empty the can into the large can with a screen bottom in the following apparatus:



light source (plug in)

can with screen bottom (holds soil sample)

collecting jar (with alcohol in it)

Label the collecting jar.

Recording results - pour the contents of the collecting jar into a shallow glass dish. Observe under dissecting miscroscope.

NAME OR SKETCH OF ORGANISM	TOTAL NUMBER COUNTED
1.	
2.	

Supplement # 32 (Cont.)

NAME OR SKETCH OF ORGANISM	TOTAL NUMBER COUNTED
3.	
4.	
5.	
6.	
7.	

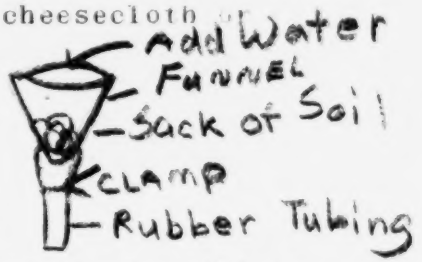
Supplement # 32 (Cont.)

2. b. NEMATODE STUDY

Materials (in lab)--funnel, cheesecloth or stocking, soil sample, rubber tubing, jar or beaker, alcohol tripod, clamp

Nematodes are microscopic round worms; some infect and destroy plants.

1. Wrap soil sample in a double layer of cheesecloth or stocking.
2. Set up the funnel as illustrated:



3. Place the sack of soil in the funnel and slowly fill the funnel with water. Nematodes will move through the cheesecloth into the water where they sink and concentrate above the clamp.

4. After 24 hours, open the clamp for a split second releasing a small volume of water containing nematodes. Collect this in the beaker or jar.

5. Centrifuge the liquid--nematodes being heavy will be thrown to the bottom of the test tube. Carefully pour off most of the water. (This step is optional)

6. With a medicine dropper, transfer a drop of the suspension left in the bottom of test tube to the micro slide. Cover with a cover glass. Observe under the microscope. The worms are transparent so look carefully.

OBSERVATIONS:

Sketch of animals seen	Total number of each counted
1.	
2.	
3.	

Supplement # 32 (Cont.)

TRANSECT #_____ Name_____

DATA SHEET # 10

SOIL ANALYSIS:

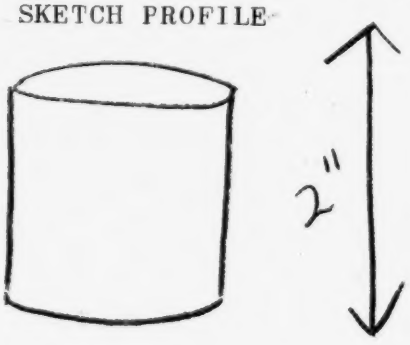
1. In the field - a. Digging downwards to eight inches, drop spoonfuls of soil into a no. 303 metal can. Try to collect equal amounts of soil from all depths.
   b. Label the can with your transect number, title it "soil analysis".

2. In the lab - a. Add tap water to the soil sample and mix.
   b. Pour this muddy suspension into your glass quart jar.
   c. Rinse the can with more water and pour the rinse water into the glass jar.
   d. Fill the glass jar with water. Shake well.
   e. Label the jar with your station number.

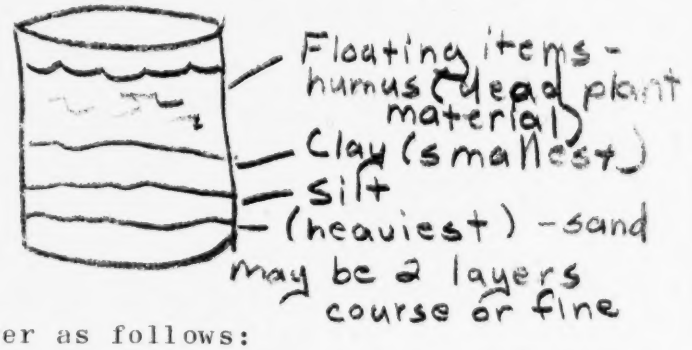
3. Comparing results -

   Directions: After the soil has completely settled (about 2 days) draw a profile of the different layers.

A. SKETCH PROFILE



MODEL OF A PROFILE



B. Calculate the % of each layer as follows:

$$100 \times \frac{\text{depth of one layer}}{\text{total depth of soil}} = \_\_\_\_\_\ \%$$

Make this calculation for all the layers.

sand _____ %

silt _____ %

clay _____ %

Supplement # 32 (Cont.)

Transect #_____ Name_____

DATA SHEET # 10 - Alternate

SOIL ANALYSIS:

1. In the field--collect one "tuna fish-size" can of soil from your station.

2. In the lab--follow the directions on "Pre-activity: Soil Analysis" lab sheet. (Supplement # 29)

3. Results -

Gravel: Weight_____ _____ X 100 = _____%

Sand : Weight_____ _____ X 100 = _____%

Silt : Weight_____ _____ X 100 = _____%

Clay : Weight_____ _____ X 100 = _____%

Total : Weight_____ _____ X 100 = _____%

SOIL CLASSIFICATION: _____

NOTE: This is an alternate procedure for soil analysis.

Supplement # 32 (Cont.)

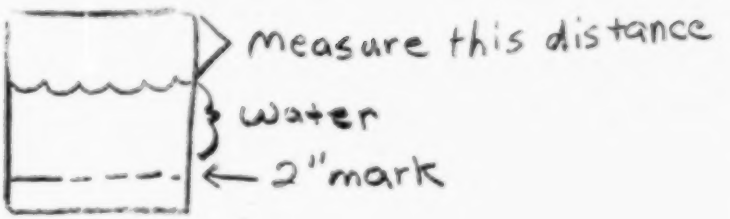
Transect Station # _____ Names_____

DATA SHEET # 11

SOIL PERCOLATION

Materials needed:

1 juice can, ruler
quart jar, timer



Directions:
In the field----

1. Remove both ends from the juice can.

2. Mark the can 2" from the end, place the can upright on the soil to be examined, cover with a board and drive into soil to the 2" mark.

3. Pour 1 quart of water into the can and measure distance of the water line from the top of can each minute for 10 minutes. Then measure after 10 more minutes. Continue measuring at 10-minute intervals till all the water has disappeared.

DATA:

TIME ELAPSED	DISTANCE OF WATER FROM TOP OF CAN
(start) 0	
+1 min.	
+2 min.	
+3 min.	
+4 min.	
+5 min.	
+6 min.	
+7 min.	
+8 min.	
+9 min.	
+10 min.	
+20 min.	
+30 min.	
+40 min.	

POST-ACTIVITY PLANS

A Transect Study-The Ecologists' Thing

UNIT IV: TO EACH HIS OWN

TIME: 3 periods

TO THE TEACHER:

1. Forty-eight hours after initiation, the "soil animals" and "soil analysis" studies can be completed and the results posted on appropriate charts (Supplement # 31).
2. Students can analyze the data, with the assistance of a questionnaire similar to Supplement # 33.
3. Follow up study with class discussion to point out the correlation between biotic and abiotic factors. Students should be reminded that even if student error masks existing relationships, or results in erroneous conclusions, the research techniques employed are invaluable and should be mastered. The usefulness and shortcomings of the transect study can be discussed.

STENCIL

SUPPLEMENT # 33

Analyzing The Data

Answer These Questions Concerning Temperature:

1. Which of the 3 temperatures (surface, soil, sub-soil) is usually warmest?

2. Which 2 stations show the greatest difference in temperature? Is it surface, soil, or subsoil?

3. Look at the other charts and see if these 2 stations are very different in any other ways (aside from temperature). Write down any differences you find.

4. Does a certain temperature seem to go along with certain other factors we measured?

5. What other features of interest did you discover concerning the temperatures?

STENCIL

SUPPLEMENT # 33

Analyzing The Data

Answer These Questions Concerning Soil Types:

1. Examine the displays for different types of soil. If there is a difference among any of the samples, can you explain why such a difference might exist? If there is no difference, can you explain why?

2. Do you see any pattern of change in soil type moving from the first station through the last station?

3. Do the types of vegetation change as the soil changes?

4. Is there a relationship between <u>percolation rate</u> and <u>soil type</u>? What is it?

5. Can you find any pattern between type of soil and any other factor that was measured (like type of plant, amount of moisture, temperature)? What is it?

6. If the soil samples mainly look the same, what conclusion can you make about the relationship between soil and types and numbers of vegetation in the area we studied.

7. Study the soil and subsoil temperatures. Are they different? Why? Why not?

STENCIL

SUPPLEMENT # 33

Analyzing The Data

Answer These Questions Concerning Wind:

1. Does the force of the wind vary much along the transect?

2. Are there any physical obstructions or land characteristics which change as the wind velocity changes along the transect?

3. Study the wind and insect charts station by station. Does there seem to be a relationship between the amount of wind and air insects? Explain the relationship.

4. Is there a relationship between amount of wind and surface temperature? Explain.

5. Is there a relationship between amount of wind and amount of soil moisture? What is it?

6. Is there a relationship between amount of wind and the presence of certain types of vegetation?

STENCIL

SUPPLEMENT # 33

Analyzing The Data

Answer These Questions Concerning Moisture:

1. Is there a relationship between the amount of moisture in the soil and the kinds of vegetation present in the stations? What is it?

2. Is there a relationship between the amount of moisture and the numbers of certain plant types in the stations? What is it?

3. Is there a relationship between the amount of moisture and the <u>kinds</u> of insect types found on the ground? Explain.

4. Is there a relationship between moisture and <u>numbers</u> of different insect types found on the ground? Explain.

5. Why are there different amounts of moisture? Is there a relationship between moisture and amount of sunlight? Between moisture and temperature? Between moisture and soil types? Between moisture and soil percolation rate?

STENCIL

SUPPLEMENT # 33

Analyzing The Data

Answer These Questions About Plant Types:

1. Select any plant type. Study the following relationships concerning this plant type (you will be finding out what factors--biotic and abiotic--determine where it grows the best).

   a. Is there a relationship between this plant and amount of soil moisture? Does it only grow in the wet station? Are there more of this type in the wet stations than the dry?

   b. Is there a relationship between this plant and temperature? Explain.

   c. Is there a relationship between this plant and amount of sunlight? Explain.

   d. Is there a relationship between this plant and certain other plant types? Explain.

   e. Is there a relationship between this plant and the number or kinds of insects present? Explain.

   f. Is there a relationship between this plant and the amount of wind in different stations? Explain.

2. Answer the same questions for as many different plants as you have time.

UNIT IV: TO EACH HIS OWN

INTRODUCTION TO ACTIVITY

The Adaptation Angle

TIME: 3 periods

GOAL:

For students to know that all organisms have certain structural and physiological characteristics that enable them to survive in a specific environment; that different organisms adapt in different ways to the same environmental factors.

INTRODUCTION:

Although it was difficult at first to think outside the realm of "conventional" organisms, our students soon found it stimulating to create 'super-adapted' mythical plants and animals and eventually realized that the more diversified the organism, the greater its chance of survival.

MATERIALS:

paper and crayons or pencils

PRE-ACTIVITY PLANS

The Adaptation Angle

UNIT IV: TO EACH HIS OWN

TIME: 1½ periods

TO THE TEACHER:

Present students (groups or individuals) with an environmental parameter (see list below). Ask them to sketch and describe one, two, or three completely different organisms that could survive and reproduce in the environment. Students must be prepared to justify the adaptations of the organisms.

Dependent upon their ability, more than one parameter can be included and the level of sophistication of the adaptations heightened.

Impose a time limit on the students' creations and stimulate debate and competition in judging each others' results: which organism appears to be the most adapted?

Emphasize the <u>variety</u> of adaptations possible for each parameter. Examples of environmental parameters:

1. The environment is terrastrial, rocky and steep.

2. The organism falls prey to large, swift animals with sharp teeth.

3. The temperature ranges from -20°F (winter) to 105°F (summer).

4. The organism is a herbivore and has no natural predator. Describe: (a) it's teeth; (b) it's ability to hear

   NOTE: hearing may not be essential in this case because it isn't needed to find food or for protection.

5. The atmosphere doesn't carry sound waves. Describe: (a) the organism's sense organs; (b) how it communicates; (c) how it protects itself from predators.

6. The environment is aquatic.

7. The winters are long and severe. Snow covers the ground all winter. The animal is a herbivore.

8. The organism is a producer. The climate is mild all year but there is very little rainfall, and rainfall occurs only one month each year. Consider: (a) its physical appearance; (b) reproduction.

9. The habitat is terrestrial, but frequent floods do occur.

10. The organism is preyed upon by a bird. It's habitat is the sand of a beach.

SUGGESTIONS:

1. Students should consider adaptations for the following:

   a. protection
   b. how it reproduces including litter size and frequency
   c. how it obtains and eats its food
   d. how it moves
   e. sense organs
   f. coloration, shape, type and number of appendages
   g. type of behavior including hibernation and time of day it's active

ACTIVITY PLANS

The Adaptation Angle

UNIT IV: TO EACH HIS OWN

TIME: 1½ periods

TO THE TEACHER:

Divide the class into groups of 4-8, plus one judge per group. Supply crayons and paper.

Each team designs an environment which includes as many biotic and abiotic factors as the team wishes. The judges will award one point for every reasonable factor included. Allow 20-25 minutes for this activity.

The judges switch environments among the groups. Each group must then construct an organism that is well adapted to living in the environment with which the group has been provided. The judging team will award one point for each adaptation and subtract one point for each liability (i.e. inappropriate adaptation) and each environmental factor to which the organism isn't adapted.

The points awarded for the environment and the organism are totalled for each group and the winning group announced. An award (bubble gum or a special privilege granted) is recommended.

Each group can describe the environment they developed and the organism that was created by another group to live in that environment.

SUGGESTIONS:

1. If you encourage originality you will be delighted and amazed by the clever and unique environments and organisms that will be devised!

2. The activity can be played in reverse, by having each team design <u>in detail</u> an organism and challenge the other team to reconstruct that organism's environment, including relevant biotic and abiotic factors.

UNIT IV: TO EACH HIS OWN

INTRODUCTION TO ACTIVITY

An Adaptable Treasure Hunt

TIME: 2 periods

GOAL:

For students to learn to look for and appreciate the multitude of ways in which all organisms have adapted to specific factors in their environment. For students to know that there are many different ways to adapt to a particular environment.

INTRODUCTION:

Students can become more involved in this treasure hunt by making the lists themselves (refer to Teacher Supplement # 34). The students do not look for specific organisms; they look for organisms that have specific adaptations. Since it would be difficult in some cases to carry back whole organisms, a piece of the organism can be collected.

MATERIALS:

PER GROUP

list of items for treasure hunt

bag to collect items in

TEACHER

whistle

Supplement # 34, "Suggested List for Treasure Hunt"

TEACHER SUPPLEMENT # 34

*Suggested list for the Treasure Hunt

BRING BACK A PIECE OF/OR WHOLE ORGANISM THAT HAS ADAPTED TO THE FOLLOWING:

1. having its tail cut off frequently
2. not being able to run away from an animal that will eat it
3. having to prey upon animals that can move much faster than it can move
4. not being able to move in order to obtain water
5. being prey to an animal that moves much faster than it can move
6. living in an area where the ground is very shaded, but requiring a lot of sunlight
7. having to depend upon another species to help it reproduce

*The list should be varied depending upon the kind of community available for the hunt.

PRE-ACTIVITY PLANS

An Adaptable Treasure Hunt

UNIT IV: TO EACH HIS OWN

TIME: 1 period

TO THE TEACHER:

If the students have the ability and the willingness, they can be divided into groups and each group asked to prepare a list of specimens to be collected on a treasure hunt. Lists will be exchanged before the hunt.

The groups should know that they'll be penalized (e.g., lose points) for any ridiculous item included. Let the class decide how long the list should be.

The items should be similar to those referred to in Supplement # 34. It may be helpful to give a few examples from the supplement to get the students started in the right direction.

ACTIVITY PLANS

An Adaptable Treasure Hunt

UNIT IV: TO EACH HIS OWN

TIME: 1 period

TO THE TEACHER

Take the students to an area suitable for finding the kinds of organisms included on the lists and allow an agreed-upon span of time for the hunt.

Recall the students, and permit each group to show what they have found and justify its suitability.

UNIT V PLAN

UNIT V TITLE: "THE ONLY THING CONSTANT IS CHANGE"

TIME: 7 to 8 periods

PURPOSE OR OBJECTIVE:

For students to know that environments are constantly changing-due to both biological and physical influences.

For students to know that all organisms, including man, are continually making their environment less inhabitable for themselves, but perhaps more inhabitable for other kinds of organisms.

For students to know that all organisms are dependent upon each other and upon their physical environment.

ABSTRACT:

There are very many examples of succession in every area. Two have been selected to study in detail following a short introduction to succession through reading and discussion. The first activity is a field study during which the students are shown examples of the main stages of 'old field succession' as it occurs in eastern North Carolina. The second activity is a microscopic study of succession as it occurs in a hay infusion broth*.

*This broth must be started by the teacher 4-5 weeks before the students use it. See Supplement # 36 for details.

UNIT V SCHEDULE

A Progressive Field Trip	Pre-Activity	2 periods
	Activity	2 periods
Change in the Unseen World	Pre-Activity	2 periods
	Activity	1 period

SUPPLEMENTS

35. A Progressive Field Trip (Old Field Succession)
36. Preparation of Hay Infusion Broth
37. The Compound Microscope
38. Identifying the Parts of the Microscope
39. Using The Compound Microscope
40. Care of the Microscope
41. Succession in a Hay Infusion Broth

UNIT V: "THE ONLY THING CONSTANT IS CHANGE"

INTRODUCTION TO ACTIVITY

A Progressive Field Trip

TIME: 4 periods

GOAL:

To learn how and why natural communities are continuously changing, and the effects these changes have on all biotic factors including man; by observing areas in various stages of succession and discussing the reasons for their existence.

INTRODUCTION

Any biology or ecology text will have ample information concerning ecological succession. A balance of reading, discussion, and direct observation is the approach used in this unit.

MATERIALS:

Reference books--ecological succession

Supplement # 55, "A Progressive Field Trip"

FRE ACTIVITY PLANS

A Progressive Field Trip

UNIT V: "THE ONLY THING CONSTANT IS CHANGE"

TIME: 2 periods

TO THE TEACHER:

Provide a reading day, so that students can research a list of key questions to be discussed the following day (see list below).

On the second day discuss the major aspects concerning succession. The following is a suggested list of questions:

1. What is succession?

2. Describe how and why succession occurs in: a forest, a pond, a fallen log, a beach, a marine environment.

3. Does succession always occur over a long period of time? NOTE: Often a natural disaster or man-induced alteration causes an abrupt change. E.g.: Excessive discharge of human sewage into a slow-moving or stagnant body of water leads to an algal bloom and premature eutrophication.

4. Does succession always follow the same pattern in all environments? NOTE. There are many interacting factors determining succession in any community. Such factors as precipitation, proximity of seed sources, climatic changes, migrational habits of neighboring fauna, intervention of man- all account for the specific seral stages in any particular community.

5. What natural and man-induced occurrences can disrupt succession?

It is important to note that every organism changes its environment, making the environment less inhabitable (loss of food, water; accumulation of wastes). The organism has 3 alternatives: adapt, move, or die. Man is no exception! And we have no place left to move. . .

ACTIVITY PLANS

A Progressive Field Trip

UNIT V: "THE ONLY THING CONSTANT IS CHANGE"

TIME: 2 periods (2-hour field study)

TO THE TEACHER:

The field study undertaken shows students the stages in old field succession, a very common occurrence in our area. The students are driven a short distance from the school and are given time to survey each stage by walking through the study areas, asking and answering questions.

An example of the field study data sheet is included (Supplement # 55), but this activity should be modified to suit your own environment. Refer to an ecology text for examples of succession in all kinds of natural communities.

STENCIL

SUPPLEMENT # 55

A Progressive Field Trip

(Old Field Succession)

NAME _____

DIRECTIONS: a. Read the description below of the obvious stages seen after a field is abandoned--or a fire destroys a forest. As we drive, look for examples of each. The bus will stop beside an example of each seral stage.

b. Each stop will be given a different number. Write the no. of the stop beside the stage you see represented.

c. Also answer any questions asked at that stage and describe carefully the plants you see and the type of soil (pick up some soil to look at it).

STOP NO.	STAGE	CHARACTERISTICS
_____	1. 1st SERAL STAGE	short crabgrass; tall horseweed (2-5ft.); vegetation is thick

QUESTION: Is there much dead material mixed in with the soil? _____

ADDITIONAL DESCRIPTION:

PLANTS---

SOIL---

ANIMALS---

_____ 2. 2nd SERAL STAGE abandoned about 2 years; wild asters are tall (2-5ft) and thick; ragweed is shorter and not as dominant. Also see some remains of 1st stage (horseweed, crabgrass)

ADDITIONAL DESCRIPTION:

PLANTS---

SOIL---

ANIMALS---

Supplement # 55 (Cont.)

Stop No.	STAGE	CHARACTERISTICS
_____	3. 3rd SERAL STAGE	broomsedge is thick; pine seedlings are small; will exist this way for several years

ADDITIONAL DESCRIPTION:

PLANTS---

SOIL---

ANIMALS---

QUESTION: How do pine seedlings get here?

Why don't pine seedlings grow sooner than the 3rd stage?

_____ 4. 4th SERAL STAGE about 10-16 years since field was abandoned; pines are about 10 ft. tall; pines are dominant; hardwood seedlings are present but much smaller than pine; look for dogwood, red maple, beech, gum, oak, hickory

QUESTION: Why are the hardwoods just now beginning to grow?

ADDITIONAL DESCRIPTION:

PLANTS---

SOIL---

ANIMALS---

_____ 5. 5th SERAL STAGE about 150 years since field was abandoned; no pines except along the edge or in open areas; hardwoods are tall, if woods are very old, oak and hickory will be dominant

QUESTION: Why do the pines die out except along the edge and in open areas?

How do lumber companies prevent this stage and maintain pine forests?

Do abandoned fields all over the world progress the same way they do in eastern North Carolina?_____
Explain.

Supplement # 35 (Cont.)

STOP NO.	STAGE	CHARACTERISTICS
		ADDITIONAL DESCRIPTION:
		PLANTS---
		SOIL---
		ANIMALS---

FINAL QUESTIONS:

Which is the 'pioneer stage'? (circle it)

Which is the 'climax stage'? (draw a box around it)

UNIT V: "THE ONLY THING CONSTANT IS CHANGE"

INTRODUCTION TO ACTIVITY

Change In The Unseen World

TIME: 4 periods

GOAL:

To observe the seral stages in a hay infusion broth as an example of ecological succession that goes unnoticed - and therefore generally unappreciated.

INTRODUCTION:

The hay infusion study is important for two reasons: the plankton observed are unseen but so vitally necessary to all aquatic food chains (as producers, as well as reducers and decomposers); and students love to use a microscope!

It is necessary to plan 6 weeks in advance (see Supplement # 36).

MATERIALS

PER CLASS	PER GROUP
reference books	1 micro-slide
hay infusion broth series	1 coverslip or square of plastic wrap
	1 medicine dropper
	1 microscope
	Supplement # 41

TEACHER SUPPLEMENT # 36

Preparation of Hay Infusion Broth

GENERAL PROCEDURE:

1. Cut up dried hay/grass into small pieces.
2. Add a small handful of hay to a jar.
3. Fill the jar with distilled water, well water, or tap water that has stood uncovered overnight.
4. Add a couple drops of pond, ditch, or aquarium water.
5. Cover lightly, date and label (see below), set in a warm area exposed to indirect light.

SPECIFIC INSTRUCTIONS:

Succession takes 1-2 months, so beginning 6-8 weeks before the exercise, prepare a hay infusion broth once a week, labelling the first broth "STAGE 6 (or 8)", the second broth "STAGE 5 (or 7)", continuing in this manner through the last broth (which should be prepared the day of the lab) labelled "STAGE 1".

PRE-ACTIVITY

Change In The Unseen World

UNIT V: "THE ONLY THING CONSTANT IS CHANGE"

TIME: 2 periods

TO THE TEACHER:

Introduce the students to the use of the microscope. Supplements # 37, # 38, # 39, and # 40 are provided for this purpose. If students claim to know how to use a microscope, supplements # 38, # 39 (demonstrate ability), and # 40 can be used as a pre-test and students who perform exceptionally well can be permitted to use the microscope (e.g. staining bacteria, looking at ditch water) while the other students learn how to use the microscope properly. This pre-activity is very essential since most individuals brutally misuse microscopes which are very costly to repair.

STENCIL

SUPPLEMENT # 37

The Compound Microscope

The invention of the compound microscope opened a whole new world of minute plants and animals whose existence had never been dreamed of. The microscope also made it possible to study tiny portions of plant and animal bodies in great detail. This is an expensive and delicate instrument and must be handled with great care.

The parts of a microscope may be divided into three groups (see diagram, Supplement # 39):

1. The optical parts (lenses in metal holders)

   a. An eyepiece, or ocular. . .This is the part to which you bring your eye when you use the microscope. (No. 7)

   b. One or more objectives. . .An objective is a combination of lenses in the lower end of the tube. It is placed directly over the obje t when in use. (NO. 8)

2. The mechanical parts

   a. A stand made up of a heavy base (No. 1) supporting an arm (No. 12)

   b. A horizontal stage, or platform, with a hole in it through which light can pass (No. 4)

   c. A vertical tube, or cylinder, which holds the optical parts (No. 9)

   d. A nosepiece, to which two or more objectives may be attached. . .To change from one objective to another, you simply rotate the nosepiece until the desired objective clicks into position. (No. 6)

   e. Wheels or knobs with ridged edges. . .Turning any of these focusing knobs will raise or lower the tube and thus move the objective farther from or nearer to the stage.

      1. The larger wheels are the coarse adjustment. They move the tube quickly through the full range of its motion. (No. 10)

      2. The smaller wheels are the fine adjustment. They move the tube slowly through a small distance, and enable you to make slight changes in the position of the tube. (No. 11)

Supplement # 37 (Cont.)

f. Metal clips which are made so that they can hold a glass slide in position on the stage (No. 5)

3. The illuminating parts

a. A mirror, arranged so that it can reflect light up through the stage to the objective. . .The mirror may have two sides; a flat side, which is used for light coming from a distance (such as light from a window); and a concave side, which is for a nearby light source (such as a lamp). (No. 2)

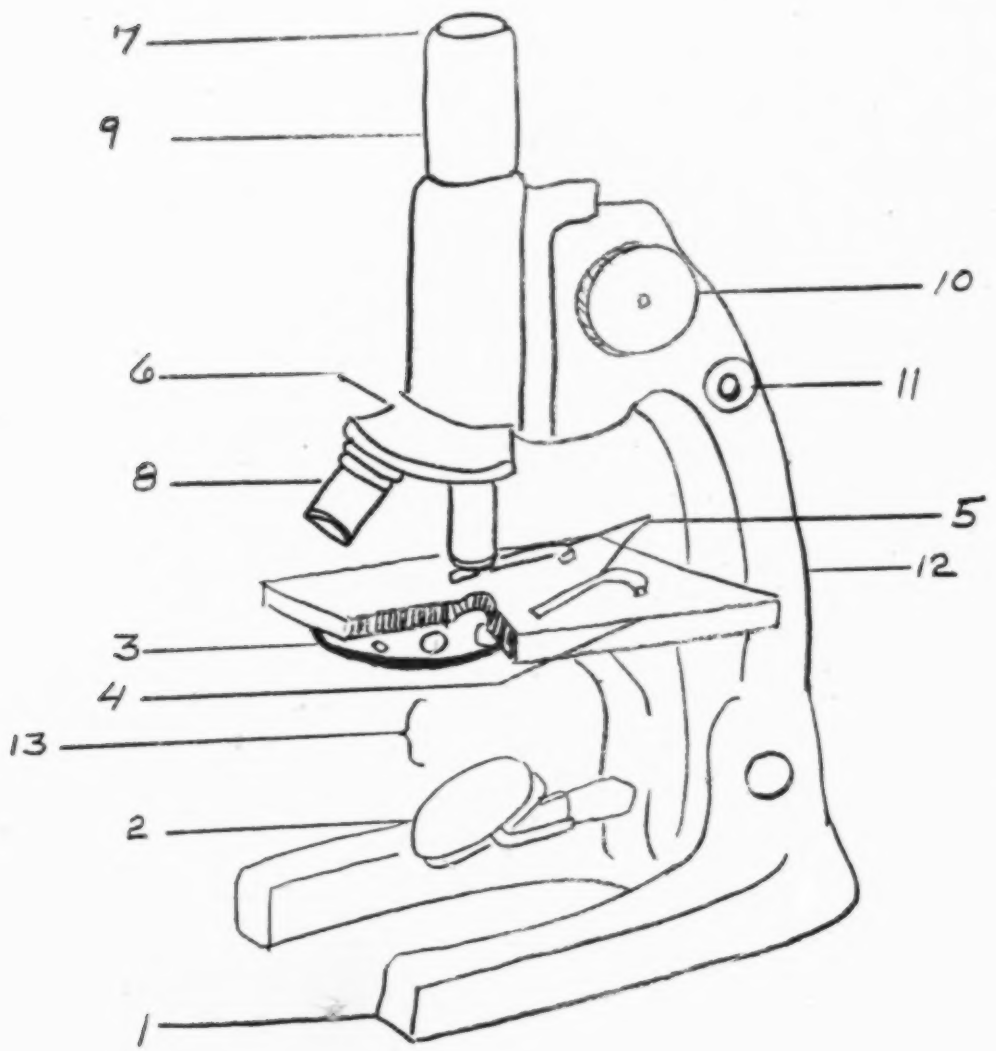
b. A diaphragm, which regulates the amount of light that passes through the stage. . .The diaphragm is on the underside of the stage. It may be a disk with holes of different sizes, or it may have a continuously adjustable iris opening. (No. 5)

c. A condenser may be attached. This concentrates the light collected by the mirror. The closer it is placed to the stage, the brighter the light (use this way for 43 X or higher). (No. 15)

STENCIL

SUPPLEMENT # 38

IDENTIFYING THE PARTS OF THE MICROSCOPE: IDENTIFY THE PARTS OF THE MICROSCOPE PICTURED BELOW. PLACE THE NAME OF THE PART IN THE BLANK BESIDE IT.



STENCIL

SUPPLEMENT # 59

Using The Microscope

How to prepare and mount a specimen on a slide

The material, or specimen, that is to be examined under the microscope is usually placed on a rectangular piece of glass called a micro-slide. A very thin piece of glass, called a cover slip, is placed over the specimen.

1. How is a specimen mounted on the slide?

The material to be studied is usually placed in a drop of water, or dilute stain that has been placed at the center of the slide. Then one edge of the cover slip is placed on the slide next to the drop of liquid and is slowly allowed to drop, completely covering the specimen and the drop of liquid.

2. Why is it necessary to rest one edge of the cover glass on the slide before lowering the cover glass?

One edge of the cover slip is placed on the slide next to the drop of liquid and is slowly allowed to drop, completely covering the specimen and the drop of liquid. Laying the cover glass in this manner prevents air bubbles from forming under the cover glass.

To become familiar with the microscope, it is best to start with a specimen that is easy to handle and that can be seen with the naked eye, too. The printed letters in a newspaper make good subjects for this purpose. From the newspaper cut a small piece of paper containing the letter "e". Mount this piece of newspaper in a drop of water on a slide and cover with a cover glass as directed.

Now follow the directions in the next section for examining this slide under the microscope.

Supplement # 39 (Cont.)

How to Examine the Specimen under the Microscope

1) Turn the nosepiece until the shorter objective (low power) is in direct line with the tube. You will hear a click when the position is correct.

2) Set the diaphragm at its maximum opening.

3) Get your light--turn the mirror toward your source of light. Looking through the eyepiece, move the mirror around until you get the brightest light possible.

4) Place the prepared slide on the stage in such a way that the piece of newspaper is in the center of the opening of the stage and the printing is right side up.

5) While looking at the microscope from one side, turn the coarse adjustment downward until the objective is very close to the slide.

6) Now look through the eyepiece and turn the coarse adjustment upward until you see the newspaper letters clearly. Take hold of the edges of the slide with the tops of your thumbs and slowly move the slide until you see the letter "e".

STENCIL

SUPPLEMENT # 40

Care Of The Microscope

Give reasons for the following rules regarding the care of the microscope.

1. When carrying the microscope, keep the instrument in an upright or vertical position by holding the arm of the microscope with one hand and using the palm of your other hand to support the base.

2. Before putting the microscope away, turn the coarse adjustment wheel until the nosepiece is all the way down.

3. Always keep the clips turned in.

4. Use only soft lens paper to clean the lenses and mirror.

5 Always clean the microscope before and after using.

ACTIVITY

Change in the Unseen World

UNIT V: "THE ONLY THING CONSTANT IS CHANGE"

TIME: 2 periods

TO THE TEACHER:

A wet mount can be prepared for each hay infusion broth and set up under microscopes before the students arrive, or the students can work in as many groups as there are microscopes available, preparing their own wet mounts of each hay infusion broth. Refer to Supplement # 41 for the lab procedure. Explain how the hay infusion broths were prepared. Most biology texts contain a description of succession in a hay infusion broth.

Questions at the conclusion of the lab can be discussed after all students have studied the hay infusion broths.

STENCIL

SUPPLEMENT # 41

Succession In A Hay Infusion Broth

LAB PROCEDURE:

As you probably know, pond water is inhabited by many forms of plant and animal life. In order to study these microorganisms it is necessary to make a temporary preparation or wet mount. This is done as follows:

1. Carefully clean (tap water) and polish (clean handkerchief) a microscope slide and cover slip.

2. Obtain two drops of hay infusion broth and place carefully in the center of the slide.

3. Now carefully touch a cover slip to the edge of the drop of water. Gently lower the cover slip onto the drop of water. Blot excess water with paper towel.

(1) With a medicine dropper put 2 drops of water on the slide.

(2) Touch a cover slip to the edge of the water.

(3) Gently lower the slip onto the water.

THIS MUST BE DONE CAREFULLY OR AIR BUBBLES WILL FORM UNDER THE COVER SLIP.

4. Place the prepared slide on the microscope stage, clip into focus. Use the 4x, 10x, 40x, or 43x objective.

5. Observe as many organisms as possible. Make a diagram of each on the data sheet. Use a reference book for identification. These organisms, too small to be seen with the unaided eye, are some of the most important in maintaining the balance of life in a pond. These microscopic organisms make it possible for larger organisms to exist. Not only are they food for larger organisms,

Supplement # 41 (Cont.)

but they also reduce organic matter to inorganic materials. These materials are used by photosynthesizing plants. Some of the microorganisms are themselves photosynthetic. In fact, 70-90% of all our oxygen is produced by marine phytoplankton.

6. When you are through, wash and dry the microscope slide and cover slip and put away. Then clean the microscope and put away.

Supplement # 41 (Cont.)

DATA: DATE_____

EXAMINATION NO. 1 1st Stage of Succession

Type Organism (sketch or name)	Size: Small Medium, Large	Abundance (single one, very rare, rare, many, very many)	Comments

DATE_____ EXAMINATION NO. 2

Organism	Size	Abundance	Comments

DATE_____ EXAMINATION NO. 3

Organism	Size	Abundance	Comments

DATE_____ EXAMINATION NO. 4

Organism	Size	Abundance	Comments

Supplement # 41 (Cont.)

DATE_____ EXAMINATION NO. 5

Organism	Size	Abundance	Comments

DATE_____ EXAMINATION NO. 6

Organism	Size	Abundance	Comments

DATE EXAMINATION NO. 7

Organism	Size	Abundance	Comments

CONCLUSIONS:

1. What causes the change in kinds and numbers of organisms from week to week?

2. Where do the organisms come from?

3. How does this hay infusion display succession?

UNIT VI PLAN

UNIT VI TITLE: ADVERSITY AND DIVERSITY

TIME: 4 periods

PURPOSE OR OBJECTIVE:

To help students learn that all organisms are interdependent and dependent upon their physical environment.
To reinforce in students the concept that environments are constantly changing.
To further show students that man is an integral part of an ecosystem and capable of vastly affecting it.
To help students learn that the more diversity there is in an individual, community or ecosystem the more stability there is.

ABSTRACT:

The first activity dominates the unit. Each student is asked to represent an organism in a community. Each organism has a set of specific adaptations making it dependent upon physical and biological factors in the community. The teacher presents a 'stress' on the community (e.g. disease) and each individual must decide the effect on his organism. There are two communities, one diverse and the other simple. The same stress applied to each has very different results.

The second activity is a routine field study. The students are shown various kinds of communities and asked to predict how the community will respond to specific stresses.

UNIT VI SCHEDULE

Simulating Survival Under Stress	Pre-Activity	1 period
	Activity	2 periods
Can You Predict Peril?	Activity	1 period

SUPPLEMENTS

42. Diversity Cards - Complex Ecosystem
43. Diversity Cards - Simple Ecosystem
44. Suggested Stress Situations and Questions

UNIT VI: ADVERSITY AND DIVERSITY

INTRODUCTION TO ACTIVITY

Simulating Survival Under Stress

TIME: 4 periods

GOAL:

To subject a naturally diverse (forest) and a man-made simple (farm) ecosystem to the same stress so students can see that a diverse ecosystem is more stable than the simple ecosystems man creates.

MATERIALS:

one diversity card per student (refer to Supplement # 42)

reference books if available (refer to bibliography)

PRE-ACTIVITY PLANS

Simulating Survival Under Stress

UNIT VI: ADVERSITY AND DIVERSITY

TIME: 1 period

TO THE TEACHER:

If you are able to obtain references concerning diversity in nature, a reading day before the activity would give the students a greater understanding of their results. The A.E.P. series (bibliography) is extremely readable for Junior High students.

ACTIVITY PLANS

Simulating Survival Under Stress

UNIT VI: ADVERSITY AND DIVERSITY

TIME: 2 periods

TO THE TEACHER:

1st period:

1. Before class prepare diversity cards (Supplement # 42) for the complex ecosystem.
2. Arrange seats in a circle.
3. Distribute diversity cards among students. If necessary, a student may carry more than one card; or a card can be shared.
4. Explain that the color of the cards indicates whether the holder is a plant or animal.
5. Students may be asked to quickly sketch what they think their organism looks like and attach this to the back of the card (facing the class).
6. Tell the students that they all belong to a natural community and explain the coding of plants and animals.
7. Ask if any of the students wish to hear another organism described. (We found that some of the "animals" were curious about what they 'ate').
8. Explain that you will introduce a 'stress' to the community and if their organism is killed by it directly, they should toss their card to the center of the circle; BUT if their organism could escape death by leaving the community, they should drop their cards in front of their feet.
9. "Stress: A fungus is blown into the community in July and infects any plant sensitive to it (check your card to see if you are susceptible). The plant dies. Wind can carry the fungus only short distances to another sensitive plant. Drop your card in the center if you are killed."

10. Once this is accomplished, have each student who dropped a card give his code. Then each remaining organism who depended upon that organism must die, or leave the community.

11. Continue the procedure of reading the code for those organisms that die or leave until there are no more effects.

12. With the complex ecosystem, there should be little effect. Ask students to express their results. They should realize that most organisms relied upon more than one other organism and therefore, the loss of one plant type had little effect on the community. Diversity means stability!

13. If there is still time remaining, introduce a different stress, such as a forest fire. This will produce devastating immediate effects. Then ask what will return in one year, in 5 years, in 15 years, in 100 years. The entire community is restored! And the pines even benefit from the fire!

2nd period: 1. Repeat procedure using the simple ecosystem (Supplement # 45). The stress is once again the fungal disease.

2. This time the effects are decimating! Nearly the whole community is wiped out! Try to get students to explain the difference. Many will realize that most of the organisms depended upon a single plant during the summer months.

3. Ask them what kind of community contains only one plant in the summer and hint until someone realizes that this "community" must be a farmer's field . . .and the fungus-sensitive plant, a "crop"!

4. Lead a discussion on how obviously unstable such simple ecosystems are and how even farms should have as much diversity as possible. Try to get the students to describe how the fungus disease could have been halted (perhaps by alternating rows or sections of different kinds of plants).

TEACHER SUPPLEMENT # 42

Diversity Cards - Complex Ecosystem (forest)

Directions:

Cut cards approximately 8" by 5". Do green for plants and 15 of another color for animals. Write the information below on the cards.

PLANT A:

Habitat
requires direct sunlight
plenty of water needed

Description
leaves remain green all year
grows rapidly
fire-resistant if 50 years or older and very tall and heavy
life span - about 75 years
maximum height - 50 feet
sensitive to fungus infection

Reproduction needs
seed can't germinate until FIRE splits the seed coat open

Situation
no. in ecosystem: 50
average age: 60 years
average height: 25 feet

PLANT B.

Description
sheds leaves in fall (is deciduous)
grows slowly
maximum height - 50 feet
life span - about 300 years
produces nuts in fall

Habitat
shade or direct sunlight
needs animal (?) to bury its seeds (nuts)
needs plenty of water

Situation
no. in ecosystem: 50
average age: 30 years
average height: 40 feet

Supplement # 42 (Cont.)

PLANT C

Description
maximum height: 1 foot
grows well regardless of amount of rainfall or sunlight
"dies down" in winter but roots store food for spring growth
perennial (comes back) every year

Reproduction
(1) pollinates itself; seed carried by wind
(2) also reproduces by runners along ground

PLANT D

Description
maximum height: 1 foot
stays green all year
life span: 5 years

Habitat
needs plenty of water
grows only in shade

Reproduction
by seeds only (pollinates itself)
(can grow back if part above ground is cut down - BUT it takes one month of warm weather to grow back)

PLANT E

Description
stays green all year
produces flowers in summer, berries in fall
maximum height: 3 feet
life span: 30 years

Habitat
grows in shade

Reproduction
(1) depends on bees and butterflies for pollination (animals 5, 6)
(2) seeds are in the berries so are carried to other areas in animals and are dropped (to germinate and take root) - animals 7
(3) if the part above the ground is destroyed, it can grow back. This takes several months of warm weather. Won't produce berries for 2-3 years.

PLANT F

Description
stays green all year
berries in fall
maximum height: 3 feet
life span: 30 years

Habitat
grows best in shade

Reproduction
pollinates itself
depends on furred animal to pick up its seed (berry), eat it digesting the seed coat, and dropping the seed in its feces.
(Depends on animal 7, 9, 10, 14)

Description (cont.)

PLANT G

Description
lives one year
produces berries in fall

Reproduction
pollinates itself
seeds don't germinate until
they have passed through the
digestive track of an ani-
mal (eg. the hard seed
coat dissolves) (9, 10, 14)

Habitat
grows in shaded areas
pollinates itself to plant A
as it grows

PLANT H

Description
perennial (lives year after
year)
keeps its leaves all year
produces fruit in fall

Habitat
needs shade
must attach itself to plant A
or B as it grows

Reproduction
(1) pollination by bees and
bird activity
(2) also reproduces by runners

PLANT I

Description
berries in fall
grows slowly
maximum height: 20 feet
life span: about 500 years

Habitat
doesn't require much water
grows in shade or direct

Reproduction
flowers in spring - polli-
nated by wind
seeds enclosed in a berry
that forms in fall -
eaten by animals who
then drop seeds in their

seeds on animals 1, 7,

PLANT J

Description
annual (lives 1 year)
maximum height: 2 feet
contains chlorophyll

Habitat
shady areas

Reproduction
flowers in late summer
pollinates itself in July
seeds drop to ground and
produce new plant in the
spring

stem: 15
: 25 years
: 15 feet

Supplement # 42 (Cont.)

ANIMAL 1

Description
average height: 1 foot
warm-blooded
can fly - 2 wings
has 2 legs with claws to wrap around branches
has feathers
stays all year

Food
fruit, seeds, berries (all plants)

Reproduction
nests in branches at least 40 feet above ground
builds nest out of twigs and leaves
lays about 3-4 eggs each spring
lives about 3-4 years

ANIMAL 2

Description
average height of adult: 1 foot
warm-blooded
feathered
has 2 legs, has feet that can grasp branches and stand on them
can fly
color: grey
mouth: is long, narrow, and hard
migrates south each winter, returns in spring

Habitat
sleeps in branches at least 15 feet above ground

Reproduction
nests in branches at least 15 feet above ground
lays about 3-4 brown eggs each spring

Food
Animals 5, 6, 8, 12

ANIMAL 3

Description
average height: 3 feet
warm-blooded
feathered
2 legs, claws to stand on round objects
can fly
remains all year

Food
1, 2, young 7, young 9, young 11

Reproduction and Habitat
nests in branches at least 35 feet above ground
lays about 2-3 eggs each spring

ANIMAL 4

Description
can fly
warm-blooded
has 2 legs, long claws
feathered - black
excellent vision

Food
dead animals 1, 2, 3, 4, 7, 9, 10, 11, 13

Reproduction and Habitat
nests in top branches of old trees A or B
lays about 2 eggs each spring

Supplement # 62 (Cont.)

ANIMAL 5

Description
has wings
average length of adult body: 1 inch
hibernates in winter
has 6 legs

Habitat
builds home in plant B only

Food
nectar in flowers of plants E, F, G, H, I

Reproduction
lays hundreds of eggs all spring and summer (in its home)

ANIMAL 6

Description and Reproduction
each female lays thousands of eggs in fall on plant E or F
young hatch in spring and feed on leaves of plant E or F but will eat leaves of D, G, or H if there is no E, F
young are white and tube-shaped, no legs or wings, about 2 inches long
the young build a protective shell around themselves in the summer, attaching this shell to plant E or F
in late summer, the adult breaks out of the shell
the adult is 2 inches long, brood wings, black and yellow in color
the adults mate in fall and female lays eggs
adults feed on nectar of plant J flowers
adults die in fall

ANIMAL 7

Description
average height: 10 inches
4 legs
fur all over body
warm-blooded
sleeps most of the winter
builds nests on branches of plants A or B
uses twigs and leaves to build nest
buries nuts of plant B in fall to eat in winter

Food
nuts, berries (plants B, E, F, G, H, I)
leaves of C and D

Reproduction
gives birth to young in late spring

Population density
1 family (insect) per 10 trees

ANIMAL 8

Description
average length: 2-6 inches
moves very slowly
cold-blooded
no legs, arms, or wings
lives in top soil

Habitat
body shaped like a tube, divided into segments, very flexible

Reproduction
each individual is both male and female but cannot fertilize itself
2 will fertilize each other - then each gives birth to several young
mate as long as weather is warm

Food
swallows soil, digesting small and microscopic plants and animals in the soil; excretes the soil

Supplement 3.42 (Cont.)

ANIMAL 9

Description
4 legs
warm-blooded
fur all over body
average height (to shoulder) 3 ft.
runs very fast
color: brown (to blend with dead parts of plants)
travels many miles every day
lives 2-3 years

Reproduction and Habitat
digs hole in ground for nest or under fallen branches
female gives birth to young each spring
litter size: 4

Food
any warm-blooded animal it can catch (animals 1, 2, 3, 4, 7, 10, 13)

Population in the ecosystem:
1 pack containing 3 families

ANIMAL 10

Description
4 legs
warm-blooded
fur all over its body
average height of adult (to shoulder): 3 feet
hibernates in winter in hollow log or under piles of fallen leaves and branches
lives about 20 years

Food
berries of plants E, F, G, H
honey made by animal F
young of animal 6
animals 5, 12
leaves of plants E and F
nuts of plant B

Reproduction
female gives birth to 2 or 3 in late winter

ANIMAL 11

Description
no legs, wings or arms
cold-blooded
maximum length of adult: 6 feet
color: brown and green patterns (to blend with plants and ground)

Habitat
lives under fallen logs and branches

Food
animals 5, 6, 8, 12

Reproduction
lays eggs in early spring and early fall: 12 each time
lays eggs under fallen branches and leaves; then young, after hatching, take complete care of themselves

ANIMAL 12

Description
has 6 legs (adult - 1 inch tall, 2 inches long)
cold-blooded
has outside skelton (exoskeleton)
lives 1 year

Life cycle
female lays thousands of eggs in fall under logs
young hatch in fall and hiberrate in topsoil overwinter

Food
in spring young feed on leaves of G, C, D, H
in summer adult feeds on leaves of C, D, G, H

Habitat
in grassy areas, hides under leaves and tall grass

Supplement # 42 (Cont.)

ANIMAL 13

Description
has 4 legs
warm-blooded
fur all over its body: brown
maximum height (to shoulder):
4 feet
lives about 20 years

Food
leaves of all plants
twigs and buds of all plants
berries (plants E, F, G, H, I)

Habitat
wooded area
can sleep on ground

TEACHER SUPPLEMENT # 43

Diversity Cards - Simple Ecosystem (Farm)

Directions:

Cut cards approximately 8" x 5", 9 green for plants (Note: there is no Plant 1) and 11 of another color for animals. Write the information below on the cards.

PLANT 2

Description
lives only one season:
September-April
maximum height: 4 inches
killed by temperatures below 7°F

Habitat
needs direct sunlight

Reproduction
plants are "sterile"
(cannot reproduce)
seeds must be sowed in fall

PLANT 3

Description
lives from April to June only
needs plenty of sunlight
maximum height: 2 feet

Reproduction
in spring bees and butterflies (Animal 1) carry pollen
seeds form in June
seeds won't drop to ground - need a furred animal for seeds to stick to (to be taken off plant)-animal D

PLANT 4

Description
maximum height: 2 inches
top dies down in winter, roots remain alive (store food), new leaves grow up in late April or May
sensitive to fungus infection

Habitat
needs plenty of sunlight

Reproduction
(1) pollinated by Animal I in midsummer (July)
seeds carried by wind in the fall
(2) also reproduces by runners

PLANT 5

Description
maximum height: 2 inches
grows in April or May
dies in June

Habitat
needs plenty of sunlight

Reproduction
(1) pollinates itself in May
seeds carried by wind in June
lay in topsoil - germinates next spring
(2) also reproduces by runners

Supplement # 43 (Cont.)

PLANT 6

Description
lives from April to June only
needs plenty of sunlight
maximum height: 2 feet

Reproduction
in spring bees and butterflies (Animal I) carry pollen
seeds form in June
seeds won't drop to ground - needs a furred animal for seeds to stick to (Animals D and K)

PLANT 7

Description
maximum height: 2 inches
top dies down in winter, roots remain alive, new leaves grow up in late April
dies in july

Habitat
needs loose, fertile soil and plenty of sunlight

Reproduction
(1) pollinates itself in May seeds carried by wind in June
(2) seeds lay in topsoil and germinate next spring

PLANT 8

Description
lives from April to June
needs plenty of sunlight
maximum height: 2 feet
needs loose, fertile soil

Reproduction
in spring bees (Animal I) carry pollen
seeds form in June
seeds won't drop to ground - needs a furred animal for seeds to stick to (Animals D and K)

PLANT 9

Description
maximum height: 1 inch
grows up in late April

Habitat
needs loose, fertile soil and plenty of sunlight

Reproduction
pollinates itself in April
seeds must be carried by Animal D and buried

PLANT 10

Description
lives from April to June
maximum height: 2 feet

Reproduction
in spring bees and butterflies (Animal I) carry pollen
seeds form in June
seeds fall to ground and germinate next April

Supplement # 43 (Cont.)

ANIMAL A

Description of Life Cycle
female lays hundreds of eggs in early fall
young hatch in fall, feeds on Plant 2
young hibernate underground through winter (Nov. - April)
young feed on Plant 3 in spring and Plant 4 in early summer
adults feed on Plant 1 through summer and early fall

Habitat
ground

Body
maximum size of adult: 1 inch long
6 legs
no wings
hard exoskeleton
cold-blooded

ANIMAL B

Description of Life Cycle
female lays hundreds of eggs in early fall - in soil
eggs hatch in early spring
young feed on Plant 4 in summer
adults feed on Plant 4 in early fall

Body
maximum size of adult: 2 inches long
6 legs
no wings
hard exoskeleton
cold-blooded
brown

Habitat
lives on ground

ANIMAL C

Description of Body
maximum length of adult: 6 inches
cold-blooded
no legs, arms, or wings
lives in the topsoil

Reproduction
each individual is both male and female but cannot fertilize itself
2 will fertilize each other - then each gives birth to several young
mate as long as weather is warm

Food
swallows soil, digests small and microscopic plants and animals in the soil; excretes the soil
only lives in fertile topsoil
sensitive to pesticides

ANIMAL D

Description
4 legs, runs very fast
fur all over its body
warm-blooded
maximum height of adult: 1½ inches

Habitat
on ground
hibernates under dirt and leaves, but will feed during mild days of winter

Food
Plants 3, 5, 6, 8, 9, 10 in spring
Plant 4 in summer and early fall
Plant 2 in winter when weather is mild

Reproduction
mates frequently - has several litters each year
litter size: about 6

Supplement 2 #3 (Cont.)

ANIMAL E

Description
very tiny
hard exoskeleton
8 legs
lives on Animal D and K
its habitat (Adult)
lives on Plant 1
its habitat (Young)

Food
as a parasite when an adult
lives on warm-blooded animals' skin - sucking fluid (including blood) from its host
when young - feeds on Plant 4

Reproduction
female cannot lay eggs till she has filled her stomach with blood from the host
eggs laid on Plant 4 in spring, young hatch in spring and feed on Plant 4 until August
young mature to adult form in August and attach to Animal D

ANIMAL I

Description
cold-blooded
no arms, wings, leg
maximum length of adult, 7 feet
has sharp teeth
green-gray to blend in with plants

Habitat
surface of ground
hibernates under twigs and leaves

Food
Animals A, G, H, J

Reproduction
female lays eggs (about 10) in spring under twigs and leaves
young can take care of themselves as soon as they hatch

ANIMAL C

Description
cold-blooded
has fangs that inject venom into its prey
no arms, legs or wings
color of body: yellow and brown pattern
length of adult: 7 feet

Habitat
ground
hibernates under leaves and twigs Nov. - April

Food
Animals D and K

Reproduction
young are born alive in spring and late summer
litter size: 6

Supplement # 43 (Cont.)

ANIMAL H

Description
hard exoskeleton
size of adult: 1 inch
8 legs
color: dark brown with
green spots

Habitat
hibernates in topsoil from
November - April, lives
on ground

Food
constructs a web across
Plants 4 (summer),
2 (winter), 3 (spring),
6 (spring), 8 (spring),
and 10 (spring)
traps and eats Animals A,
B, and E

ANIMAL I

Description
lives on ground
female lays hundreds of eggs
in early fall - in soil
eggs hatch in early spring
young feed on Plant 4 in
summer
adult feeds on Plant 4 in
early fall

Body
maximum size of adult: 3 inches
6 legs
wings
hard exoskeleton
cold-blooded
compound eyes
green

ANIMAL J

Description
no legs, arms, or wings
hard shell over soft body
length of adult: 1 inch
2 antennae with eyes on the
tips
tan color

Habitat
ground

Food
feeds on Plant 4 (summer)
and Plant 2 (winter)

Reproduction
lays numerous eggs all year
long

ANIMAL K

Description
maximum length of adult:
2 inches
4 legs, claws
brown
fur all over body, warm-
blooded
no eyes or ears
whole body senses vibrations

Habitat
lives under ground (usually
stays underground)

Food
roots of Plant 4 (summer)
and Plant 2 (winter)

Reproduction
2 litters (spring and fall)
young born alive
litter size: 5-8

TEACHER SUPPLEMENT # 44

Suggested 'Stress' Situations and Questions

The first is recommended to use for both communities since it demonstrates the greater stability of the diverse ecosystems. The second and fourth are recommended to use for the forest community if time allows.

Stress 1:

During the summer (July) a fungus is blown into the ecosystem. This fungus attaches to the leaves of any sensitive plant. It destroys the plant. The fungus produces thousands of spores that are blown by the wind a short distance. Whenever they land on a sensitive plant they multiply, killing the plant.

Questions (after all effects completed)

1. After the sensitive plants all die, it rains heavily for two weeks. What will happen [erosion, seeds of plants wash away, soil animals wash away]?
2. What will remain to grow the next year? [Probably no plants will be left].
3. How would the situation have been different if the ecosystem had looked like this in July:

sensitive plants
resistant plants
sensitive plants
resistant plants
(repeat pattern)

Stress 2:

Lightning strikes a tree during a summer storm. This causes a fire that rages across the entire ecosystem.

Supplement # 14 (Cont.)

Questions (after all effects)

1. What will come back by next summer?
2. What will come back within 10 years? How will these return?
3. What species benefited by the fire? Why?
4. When animal 7 returned would its "situation" have been just like before the fire? [No, there would be less trees, so its population would be smaller]

Stress 3:

1. The ecosystem is sprayed to kill all 'insects' (all those with hard exoskeletons and 6 or 8 legs).
2. What will die immediately?
3. What will die next?
4. In which animals will the poison concentrate? [The top carnivores]

Stress 4:

Weyerhaeuser buys this ecosystem and "clear cuts" it (this is easier than selective cutting of trees). They promise to plant pine seedlings in 5 years.

Questions

1. What will die?
2. What will leave?
3. What will return?
4. How will the ecosystem look when Weyerhaeuser drives in with its seedlings in 5 years?

UNIT VI: ADVERSITY AND DIVERSITY

INTRODUCTION TO ACTIVITY

Can You Predict Peril?

TIME: 1 period

GOAL:

For students to apply the principles they have learned concerning the stability of diverse ecosystems by scrutinizing communities near the school and classifying them as either stable or fragile (complex or simple).

INTRODUCTION:

Walk or drive around the school's neighborhood and plan a tour that will include both simple (front yards, shopping centers, farms) and diverse (fields abandoned 2-3 years, woods) communities. Consider travelling and discussion time and schedule the trip accordingly.

ACTIVITY PLANS

Can You Predict Peril?

UNIT VI: ADVERSITY AND DIVERSITY

TIME: 1 period

TO THE TEACHER:

1. Walk or drive to examples of diverse and simple ecosystems as described in the above introduction.

2. Ask the students which are most stable, and why. As you tour, discuss the kinds of stress that will destroy the simple ecosystems but not the complex: specific diseases, atypical or unseasonal weather (less likely to adapt), insect pests.

3. Also ask for solutions: planting a variety of plants (generally the animals will then naturally come), introducing carnivorous insects rather than using weed killer and insecticides.

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